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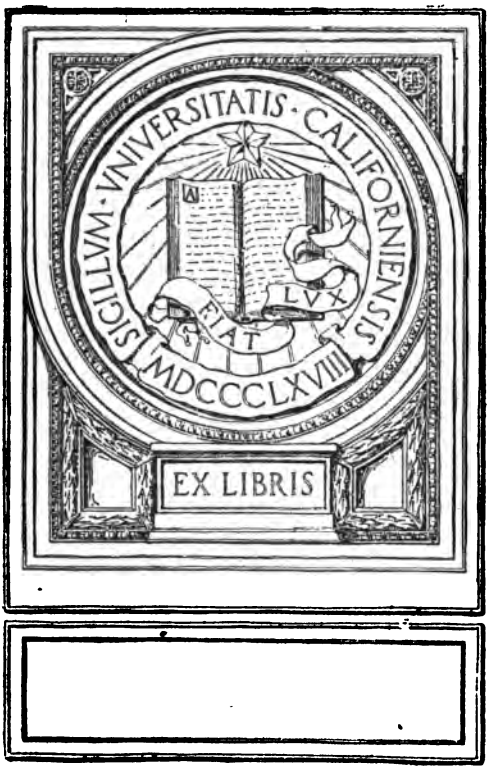
BLOOD PRESSURE
IN GENERAL PRACTICE

BY

PERCIVAL NICHOLSON, M.D.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BLOOD PRESSURE
IN GENERAL PRACTICE

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IN GENERAL PRACTICE

BY

PERCIVAL NICHOLSON, M.D.

WITH EIGHT ILLUSTRATIONS

THIRD EDITION

PHILADELPHIA AND LONDON
J. B. LIPPINCOTT COMPANY

UNIV. OF CALIFORNIA

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PREFACE TO THIRD EDITION

THE author wishes here to thank the medical profession for the kind reception which has been accorded this little volume.

It is gratifying to find that the views expressed in the first two editions have not had to be altered, but it seems wise to make several minor changes and add a chapter on blood-pressure in children, with the hope that this new subject will have a proper amount of attention.

PERCIVAL NICHOLSON.

April, 1915.

357275

Introduction

In issuing this volume it is the aim of the writer to furnish to the general practitioner and surgeon a short treatise on blood-pressure entirely from the standpoint of its practical significance and value.

So recent is the whole subject of blood-pressure, its significance, the means of determining it, and its clinical use, and so extensive is the literature on blood-pressure published mainly in journals and magazine articles, that the busy general practitioner in many cases has not been able to learn the methods of its use and application in clinical medicine.

With this in mind the author has reviewed the literature on this subject, utilizing only such materials as he deemed of clinical value, avoiding what are as yet purely theoretic findings.

This treatise therefore starts with the assumption that the writer is dealing with a new subject, and an effort has been made to present the material given in as simple a manner as possible.

In the text references have been omitted, but at the end a number will be found for those desiring to study the subject further.

The entire subject has been expressed as concisely as possible, and to some it may seem dogmatically treated and much material to have been omitted; but the author, in extenuation, wishes to state that this is not intended to be an exhaustive treatise on blood-pressure, but a simple exposition of the subject easily grasped and from a clinical standpoint.

To facilitate ready reference the diseases with changes in blood-pressure have been arranged in alphabetical order, under the general headings of hypertension and hypotension.

If this simple volume shall aid the general practitioner to a better understanding of the methods of determining the princi-

ples and some of the practical applications of blood-pressure determinations its mission will have been fulfilled.

I wish to express thanks to Dr. Wendell Reber for his kindness in reviewing the section on the diseases of the eye, making this section as condensed as possible, but at the same time giving all the essentials for the general practitioner.

PERCIVAL NICHOLSON

ARDMORE, PA.

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UNIV. OF CALIFORNIA

BLOOD PRESSURE IN GENERAL PRACTICE

CHAPTER I

GENERAL CONSIDERATION AND TECHNIQUE

HISTORICAL.—Going a little into the history of blood-pressure determination we find it dates back to 1828, when Poiselli introduced the first U-tube mercurial manometer.

Shortly after Ludwig devised the Kymographion, a manometer connected directly to an open artery, and recording on a revolving cylinder; but it was not until 1876 that a useful apparatus for estimating blood-pressure in man was used by Marey, by which he could determine both systolic and diastolic blood-pressure.

There was, however, no general use of blood-pressure apparatus until some

eleven years later (1887), when v. Bosch brought forward his apparatus, consisting of a small rubber bulb filled with water and connected with a mercurial manometer; the bulb being pressed upon the radial artery until the pulse was just obliterated, and the pressure read off the manometer. v. Bosch later modified his apparatus by using an aneroid in place of the mercurial manometer.

V. Ptoin further substituted on the v. Bosch apparatus air in place of water, which was a great advance, but both instruments have a large possible error, which Tigerstedt claims has reached 78 mm.

All our modern apparatus dates from 1896, when Riva-Rocci, in Italy, used a rubber bag, 5 cm. wide, surrounded by an inelastic material, completely encircling the arm. This cuff was connected by rubber tubing with a reservoir of mercury having an upright capillary tube, alongside of which was a mm. scale. Air was pumped into the cuff, compressing the

brachial artery until the pulse below the band was obliterated, and then, by releasing the air slowly, he determined when the pulse reappeared and thus obtained a reading of the maximum or systolic pressure, shown by the column of mercury in the capillary tube.

All instruments which give accurate readings have utilized the principle of the pneumatic constricting band, except that now the width of the cuff is at least 12 cm., as the narrow cuffs, such as the original Riva-Rocci, give too high readings. This very important error was shown by the work of v. Recklinghausen to be due to the loss of pressure in compressing the tissues, and that it could be eliminated if a cuff from 12-15 cm. wide were utilized. Dr. T. C. Janeway states he has found in high-tension cases a 5-cm. cuff to register as much as 60 mm. higher than a 12-cm. cuff.

All our modern blood-pressure determinations, as on the Riva-Rocci instrument, are recorded as the pressure measured by

the height of a column of mercury of so many mm., or, in other words, *mercury is the standard on which blood-pressure readings depend.*

The Importance of Blood-pressure and Conditions to Which It Applies.—The whole subject is one which has become prominent from a practical standpoint, in this country in about the last eleven years, though it had its beginnings as far back as 1828 in Europe.

It has been, however, only in the last five years that the importance of accurate blood-pressure readings in their diagnostic, prognostic, and therapeutic application to general medicine has begun to be appreciated, and their value realized by the general practitioner.

Blood-pressure determinations are now of so well recognized value in medicine and surgery, that one of the important questions of to-day is what are their application and meaning in special conditions, and how reliable are they when other means fail us.

Dr. T. C. Janeway has very clearly expressed the matter in a recent article, "When Should the General Practitioner Measure Blood-pressure?"

He says, in substance, it should be taken:

(1) In the first examination of every patient.

(2) Occasionally for watching the progress of cardiovascular disease and nephritis.

(3) Examination for certifying to the state of health: in life insurance; in applicants for the army, navy, police, fire department, and in schoolboys engaged in athletics; and he also mentions eclampsia and diagnosis in conditions with abdominal pain.

In addition Briggs and Cook show blood-pressure determinations to be one of the most important aids in diagnosis and treatment of eclampsia and cardio-renal disease, and their undoubted value, in typhoid fever, in medication of children; in surgery before, during, and after opera-

tive procedures, and in injuries of the head, etc.

In a paper on diagnosis read before the Michigan State Medical Association Dr. Richard C. Cabot says: "The next procedure, following my personal routine, is the examination of blood-pressure. That leads me to say something about the value of blood-pressure in physical diagnosis. If I were allowed to have only two instruments of precision for my aid in physical diagnosis, they would be the stethoscope and the blood-pressure machine.

"I have been saved from wrong diagnoses and put on the track of right ones more often by that machine than anything else I know of, except the stethoscope. And I am speaking now, as I spoke all along, by the check of the autopsy.

"I regard the measurement of blood-pressure as the most important of all the resources that have been added to our armamentarium as physicians, in the last fifteen years.

"The measurement of blood-pressure,

when you are familiar with the method, can be made in a minute and a half perfectly well."

Blood-pressure determinations are of value to the specialist in eye and ear conditions; in fact, there is no branch of medicine in which blood-pressure is not significant, and often an aid when other means of diagnosis have not been sufficient.

Definition.—By blood-pressure is meant the arterial tension or pressure of the blood in the vessels within which it is contained.

Systolic and Diastolic.—Blood-pressure is divided into the maximum or systolic pressure and the minimum or diastolic. The systolic is the greatest pressure exerted and takes place during systole of the heart; the diastolic is the lowest pressure, and occurs in the cardiac cycle just at the beginning of the systole, or at the end of the diastole, the time when most of the blood has passed on through the capillaries into the veins.

Pulse Pressure.—From these we obtain

"pulse pressure," which is the difference between the diastolic and systolic pressures.

MEAN PRESSURE.—Mean pressure is about the average between the systolic and diastolic readings, but has little clinical value and is seldom used.

Methods of Measuring Blood-pressure.—The apparatus being set up ready to operate the pneumatic cuff is adjusted snugly, and without compression, to either the arm or the thigh, usually the arm, taking care that the cuff is at the level of the heart. The cuff is then inflated until the pulse below the constriction is obliterated, which is determined by palpating the artery. The estimation of blood-pressure is then made by either one of two methods: (1) The old or *Palpation Method.* (2) The new or *Auscultation Method,* described in 1905 by Korotkow.

PALPATION METHOD.—(a) *Systolic.*—After obliterating the arterial pulsation in the vessel below the cuff, slowly release the air pressure, allowing the mercury to

fall evenly, and note the height of the column when the pulsation reappears to the palpating finger. This gives the *systolic* or *maximum* pressure, and will be found easy to obtain on all instruments.

(b) *Diastolic.*—After taking the systolic pressure allow the mercury to fall slowly, and note the varying degrees of oscillation of the mercury column. Read the scale at the base of the maximum fluctuation and it gives the *diastolic* pressure.

Or when the first change from a small to a full bounding pulse is noted read the height of the mercury column, and it gives the *diastolic* pressure.

Both methods of determining the diastolic pressure are very unreliable and not accurate nor practical in general practice.

Auscultation Method.—This is an accurate method for both systolic and diastolic determinations.—(a) *Systolic.*—As in the palpation method, having inflated the cuff until the pulse is obliterated, place the bell of an ordinary binaural stethoscope over the artery just below the

cuff. Now release the air pressure slowly and listen with the stethoscope. When the first cardiac beat passes the constricting cuff a loud, clear thump is heard and the true *systolic* pressure is obtained by reading the height of the mercury column.

(b) *Diastolic.*—In taking the diastolic pressure continue to release the air and listen over the artery. The thumping sound is followed by a murmur, and then by a second thumping sound, which becomes fainter and suddenly disappears. At the time the second thumping sound becomes fainter, again note the height of the mercury column, which gives the true *diastolic* pressure.

This last auscultation method has almost revolutionized the determination of blood-pressure, for the diastolic pressure can be as easily and accurately determined as systolic pressure, a result impossible to attain in the past, there being such a large personal element in obtaining the diastolic pressure that most observers did not attempt it.

The diastolic and pulse pressure (difference between systolic and diastolic) *are thus accurately determined by this method, and are often of even greater importance than the systolic.*

Auscultatory Blood-pressure, Sounds and Phases.—Placing a stethoscope over the brachial artery just below the constricting cuff and releasing the air pressure slowly, you hear five distinct phases in most all cases.

(1) A loud, clear thump is heard as the first wave of blood passes the constricting cuff, which gives the *systolic* pressure by reading the height of the mercury column.

(2) In a short time the first phase is followed by a murmur, which lasts for a variable period, and constitutes the second phase.

(3) After the murmur a loud, clear thump is again heard, constituting the third phase, often louder than the first phase.

(4) Then the third phase passes into the fourth, which is simply a duller sound

similar to the third and is probably produced by the return of the blood vessel to its normal caliber as the air pressure is lowered.

(5) The sounds in the fourth phase gradually become fainter until you have the fifth phase or the disappearance of all sound. The end of the third phase or beginning of the fourth phase gives the true diastolic pressure.

At the present time there has not been enough work done on the intensity of the sounds of the various phases or their relative lengths in mm. of mercury to give any positive findings, though much suggestive work has been done along this line. The intensity of the sounds of the third phase being considered of importance in determining the cardiac strength, a loud clear sound indicating a strong heart and vice versa.

The main information at present obtainable from the auscultation method is the determination of accurate systolic and diastolic pressures and from them the

pulse pressure, by the simple process of subtraction, e. g.

Systolic	160 mm. Hg
Diastolic	120 mm. Hg
Pulse pressure	40 mm. Hg

Of pulse pressure and diastolic pressures I shall have more to say later.

Auscultation Method, on What Based.—In the auscultation method it is largely a question of the physics of fluids, e. g., the artery is constricted by means of the pneumatic cuff; below it there is no arterial flow, and the vessel walls are in a semi-relaxed condition. The air pressure in the cuff is lowered gradually until the heart has power enough to drive some blood into the relaxed vessel beyond. The sudden flow of blood into the relaxed vessel sends the wall into vibration, and a loud, clear thump is heard, which gives the *systolic pressure.* In making the *diastolic* estimation there again is a physical condition of a fully expanded artery above the pneumatic cuff,

a constriction under the cuff, and an enlargement below. Fluid passing from a large tube through a constriction into a large opening makes a murmur, exactly what takes place, and when the caliber of the tube is uniform, or, in other words, when the diastolic pressure is able to overcome the constriction of the cuff, there will be no longer any loud sound. *It can easily be seen that it makes no difference whether the mercury column records each pulsation* of the heart or not, but that it shows much more easily and accurately the correct *blood-pressure than could be read if it were fluctuating very actively.*

The Inertia of Mercury and the Relation of the Oscillation of the Column to Accuracy of Readings.—Here I wish to make clear a point which has created considerable confusion in the past, the relation of the inertia of the mercury column to the determination of the diastolic pressure, and also as to whether it is of importance for the column of mercury to fluctuate with each pulsation of the heart. Were

we to adhere to the old method of reading the diastolic pressure, the lowest point of the maximum fluctuation, the mercurial inertia might be of slight importance, but from a practical standpoint it is of little significance.

When we use the auscultation method for determining diastolic readings, a method now almost universally used, on account of its ease and accuracy, the lack of fluctuation of the mercury has absolutely no disadvantage. *On the contrary, it becomes easier to obtain the true pressure reading, where the column is not actively oscillating, as is the needle of the aneroid.*

Confusion has been brought into this subject of blood-pressure due to the erroneous idea having been advanced that the actual fluctuation of the mercury column, or needle of the aneroid, is essential, it recording each pulsation of the heart.

If pulsations are to be recorded it is better to employ a sphygmograph (where

the pulsations could be preserved and interpreted, as they could not on a blood-pressure apparatus), but for the determination of blood-pressure the sphygmomanometer should be used.

To illustrate this, let us recall a little problem of physics: a pump forcing water through a pipe gives an intermittent flow. Placing an air-dome on the pipe line makes the flow continuous beyond the dome, but the pressure is equal on both sides. *So blood-pressure determination is a question of the pressure existent in the arterial system, not of the pulsation of the heart.*

CHAPTER II

BLOOD-PRESSURE INSTRUMENTS

CHOICE OF AN INSTRUMENT.—The number of instruments at present available for blood-pressure work is legion, and it is decidedly confusing to one entering this field to select a good practical instrument.

In his book, "A Clinical Study of Blood-pressure," Dr. T. C. Janeway gives the following advice on the choice of a sphygmomanometer:

(1) "Manometer must be of such construction as to give permanently exact readings.

No metal manometer yet invented remains accurate, hence this means the use of a properly graduated mercurial one.

(2) Compressing armlet must have a width of at least 12 cm.

(3) Connections must be practically non-distensible tubing.

(4) It must measure both systolic and diastolic pressure.

(5) Its application must be simple, and require not more than two to three minutes.

(6) It must be at once substantial, light, and compact, so that it may be easily and safely carried.

(7) It must not be too costly."

Instruments.—Every apparatus for determining blood-pressure belongs in one of three classes, those using:

(1) Mercury.

(2) Some other fluid medium.

(3) The aneroid, spring diaphragm or dial.

(1) The mercury type is further divided into:

A. Those having a reservoir; the mercury rising in an open end capillary tube from a zero point and having a scale graduated in millimeters.

B. Those employing the U tube.

C. Those having a short straight tube with a closed end.

Class A.—To this class belong the "Riva-Rocci," the "Cook," the "Stanton," and more recently the "Sands," a copy of the "Stanton."

I shall give you a brief description of the two simpler forms, the "Cook" and the "Stanton."

The "Cook" seen in cut No. 2 utilizes all the principles of the original Riva-Rocci instrument, consisting of a constricting pneumatic cuff connected with a mercurial manometer, and having a means of inflation. The cuff when applied over the brachial can be filled with air until the pulse at the wrist is just obliterated.

This is a fairly accurate instrument for determining systolic readings, but not having a good air release is not practical in determining diastolic pressures. It is inaccurate in that it uses a 5-cm. cuff, which gives too high readings.

Though by the use of a jointed tube it is

fairly compact, the mercury is easily spilled and the instrument fragile. Its double bulb for inflation is also a constant source of annoyance from blowouts.

Now turning to cut No. 3 the original "Stanton" apparatus is seen, a reliable instrument, but no longer manufactured.

(1) It was a large, heavy instrument, using a 10-cm. cuff, which gave too high readings.

(2) It was not very portable, requiring to be taken apart and set up when used in general practice.

(3) It was difficult not to lose the mercury.

(4) It had the same defect as the "Cook" apparatus in that it used a double rubber bulb for inflation. However, it was largely adopted and gave accurate readings when a wide cuff was used.

All the instruments of this class have their drawbacks preventing their becoming practical portable instruments. Some require the manipulation of screws and washers; some are large and heavy to

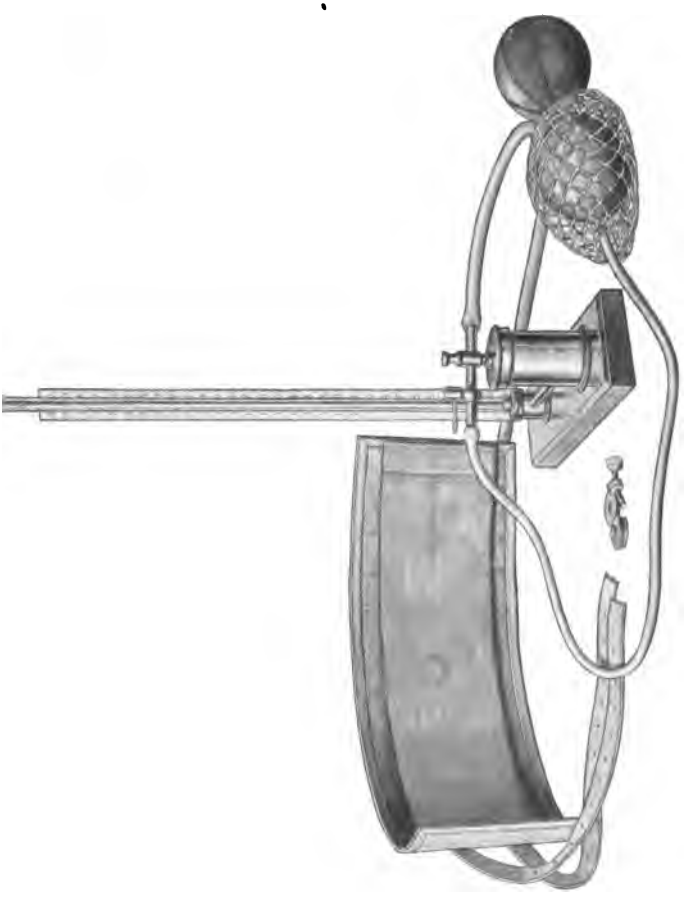

FIG. 3.—Stanton's sphygmomanometer, showing arrangement of parts, with cautery bulb-inflator.

FIG. 4.—Jaeway

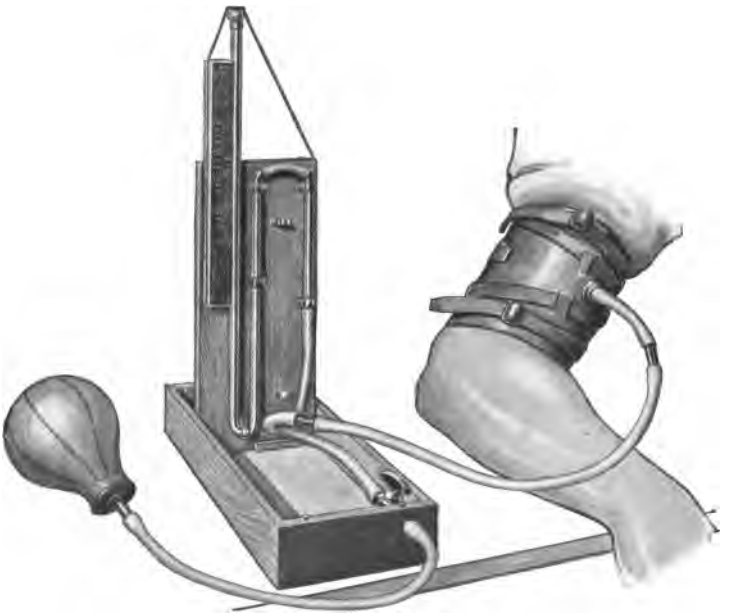

FIG. 4.—Janeway sphygmomanometer, attached to arm, showing method of retention of cuff-arrangement of momanometer, with Politzer bag inflator.

union which obstructs the reading for some 30 mm. in the middle of the scale.

(4) Like all U-tube instruments the scale has to be condensed one-half to allow for the descent of one column while the other rises, so none can be read closer than two mm.

As glass tubing cannot be blown of uniform caliber there is often a swell in one limb of the manometer precluding the mercury from rising or falling equally in both sides and as one column is balanced against the other any error is multiplied by two. Two instruments recently examined were found to vary 40 mm.

Many of the U-tube instruments are too bulky to transport and the others which are shorter, using a jointed tube, have been condemned by many because a plug must be placed in the end of the tube to prevent the spilling of the mercury.

Class C.—In order to attain portability, a greatly desired feature in blood-pressure apparatus, several instruments have been made having a short closed tube with mer-

cury working against the inclosed air, e. g., "Hertz," "Roger's Simplex," "Oliver."

These have failed because: (1) The scales have necessarily to be condensed, making the readings gross, and further this condensation greatly increases any error. (2) The scales have to be specially standardized by comparison with a mercurial column and, being fixed, cannot be adjusted to allow for any change in the compressibility of the inclosed air column, which varies greatly according to moisture, temperature, and climate.

TYPE 2.—(Instruments using fluid medium other than mercury).—These instruments are too long for portability where the open end tube is used or where the closed end tube, e. g., "Bendick air-water apparatus." They have all the disadvantages of the closed end mercurial instruments.

TYPE 3.—(The aneroid, spring diaphragm or dial).—In addition there are the aneroids or spring diaphragm instruments, following the old model of the v.

Bosch apparatus. These, while convenient in some respects, as Dr. Janeway says: "Need to be standardized frequently by comparison with a mercurial manometer, which is irksome, and they are difficult of repair.

"Depending, as they do, on a spring they wear out and are not dependable."

Their lack of dependability is clearly shown by Dr. J. W. Fischer, medical director of the Northwestern Life Insurance Company, when he says in a letter to his medical examiners: "The experience of this department with the various makes of sphygmomanometers has convinced us that the use of an instrument registering the blood-pressure with a mercurial column is preferable, although the spring or diaphragm instruments are satisfactory if occasionally checked up with a mercurial instrument."

The spring aneroid, so-called diaphragm, instruments have solved the portability problem, but have added many inaccuracies, so they are not dependable.

Fig. 5.—Roger's sphygmomanometer adjusted to arm, showing atomizer held in hand

The elasticity of a solid is a variable quantity at the best. So in the aneroid or dial instruments the expansion and the contraction lessen the elasticity until no dependence can be placed on its reaction. To compensate for this loss of elasticity the manufacturers make the dial movable so the indicator can be set at zero;* as the vitality of the drum or spring is permanently lessened, the needle does not give accurate readings at other points, and its condensed scale multiplies the errors.

The auscultatory method of obtaining the *diastolic* pressure is now well recognized as the only accurate and simple method. Here, where you are listening over the artery for the change of sound, if you observe the dial of an aneroid, the needle is showing wide excursions, making it impossible to determine the correct reading, you do not know what point in the excursion of the needle to note. This is not the case in a good mercurial instrument; the fluctuation is but slight. As *diastolic* readings are as impor-

*Recently one manufacturer has made instruments with the dial fixed, and as a result in many the needle does not come to rest on the zero point.

tant as, if not more so than, *systolic,* the fact that the *correct diastolic* reading cannot be obtained is a serious defect in this class of instruments.

Of these instruments Dr. Richard C. Cabot makes the following remarks in a paper on diagnosis: "The little instruments which are widely advertised as being very portable are splendid for the first few months, but if you do many high pressures on them, like any other aneroid instrument, they give out. The only reliable machines are those having a column of mercury, which is a bother to carry around, but which is necessary."

Finding the need for a reliable, accurate, durable, simple, portable, and inexpensive mercurial apparatus, the author has added one more to what might seem an already well-filled field.*

The instrument, as first designed, was

*Instrument described in *Journal American Medical Association,* July, 1911, and later imitated. But these copies are all liable to an error of from 10-15 mm. Hg on the high readings, due to the fact that they employ a much larger capillary tube than my original apparatus, and, as they use the same scale, there is no allowance made for the change in bore of the tube employed.

simply a short form of mercurial instrument, utilizing the open-end tube with a reservoir and so arranged that the mercury needed no pouring, and could not be spilled. By the use of a steel stopcock and flint glass there is no corrosion of the mercury. The instrument was 13½ inches long, and when closed would fit in the ordinary doctor's bag.

Accuracy was maintained by the use of a full-length mm. scale adjustable to the mercury level, allowing for changes in climate and temperature, and by the use of a wide, easily adjusted, soft cuff (14 cm.).

The air pressure was easily and steadily released by means of a needle-valve, and a metal pump, or single rubber bulb, replaced the unsatisfactory double rubber bulb.

This instrument, as time has passed, has shown its failing also in that it is not portable enough. It has become well recognized that three qualities are essential in any good sphygmomanometer to make it a useful instrument for both the clinician and the laboratory man, namely: (1) Accuracy. (2) Portability. (3) Durability.

Up to the present no syhygmomanometer has fulfilled all these requirements.

The mercury instruments some of them have had accuracy and durability, but lacked sufficient portability.

As we have seen, the aneroids or dial instruments, on the other hand, have been portable, but the statements of numerous prominent physicians have plainly shown their shortcomings in point of accuracy and durability, so that they cannot be relied upon and considered practical instruments where accuracy and certainty is the first and great essential of all good sphygmomanometers.

Recently I have invented a new pocket sphygmomanometer which I think fulfills all the qualities essential to a practical instrument: Accuracy, Portability, Durability.

The instrument consists of a rigid case, which completely encloses and thoroughly protects all the metal and glass portions. This makes it very durable and eliminates the frailty of aneroids and many mercurial instruments. The lid, when raised,

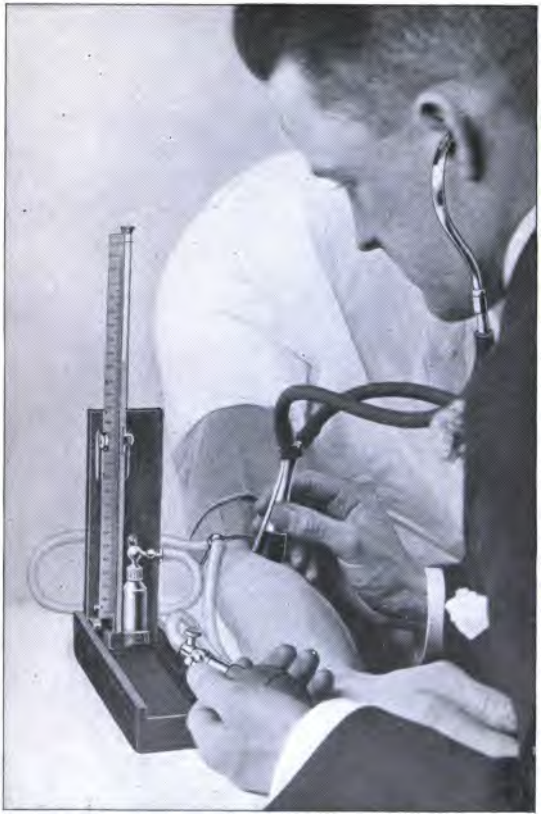

FIG. 1.—The auscultation method.

automatically locks in the upright position, and acts as a support for the instrument.

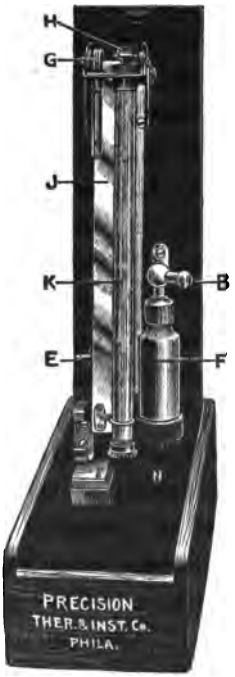

FIG. 6.—New Nicholson Prince sphygmomanometer. *B*, connection for nipple from cuff and inflation apparatus; *F*, steel mercury reservoir; *G*, metal stopcock; *K*, lower tube section; *J*, folded metal scale; *H*, clapper to close lower tube; *N*, metal cap to prevent escape of mercury; *E*, cam to lock scale at level of mercury.

By referring to cut No. 6 you will see the instrument just after the lid is

raised. On the lid is securely mounted by metal clips a cylindrical steel reservoir (F), partly filled with mercury. The top of the reservoir is connected by a union to the metal piece (B). The bottom of the steel reservoir (F) is connected by a metal base with the glass tube (K), which ends in the steel stopcock (GH) and is securely fastened to the lid by metal supports. Alongside and parallel to the tube (K) is a folded metal scale (J) which hinges in the middle and by a ring guide near its upper end is attached to the glass tube (K). On the end of the upper tube section is a steel valve cap (N) which, when the instrument is in operation, prevents any loss of mercury from overinflation. To operate raise the upper tube section (K) upward. This will carry with it the section (J') of the scale and automatically raise the clapper valve (H). The section (K) is then automatically held in a vertical position. The scale is adjusted so that the (o) is at the level of the mercury in the tube (K) and secured by clamp (E).

Now, turning to cut No. 7, you see how the union (A) is inserted into the connection (B). Be sure the needle valve (D) is closed and stopcock (C) is open, as shown in cut.

Place the large end of the soft pneumatic cuff on the arm well to the inner side over the line of the brachial artery, then wind the remaining portion of the cuff around the arm, covering each turn by the next until the tapered end is reached, when you tuck it under the preceding turn, which holds the cuff in place. Then inflate the apparatus by the bulb until the pulse at the wrist is obliterated, and use the auscultation method for the determination of the systolic and diastolic pressures. Simply release the air by opening the needle valve (C) slightly, while you listen over the line of the artery below the cuff and obtain the pressures by the auscultation method.

Though I may seem to repeat, I wish to make clear *an error* frequently quoted: "That a mercurial instrument will not record true *diastolic* pressure (minimal)."

The fact is the reverse: *No instrument can give as accurate diastolic, or for that matter systolic, readings as an accurate mer-*

FIG. 7.—New Nicholson Prince sphygmomanometer.

curial apparatus, of which this new pocket sphygmomanometer is an example.

Whether the mercury oscillates with every heart-beat is not important, we

are not recording pulsations of the heart, but the pressure present, and *no one* can obtain accurately any *diastolic* pressure by trying to determine the lowest point of the maximum oscillation of an aneroid needle or the lowest point of the maximum fluctuation of the mercury column (the old method). The difference in degree of oscillation at the various points is too slight.

The *correct* and *accurate* way to obtain the *diastolic* and *systolic* pressure is by the *auscultation* method, the method used by all the leaders in medicine to-day.

One great advantage of this new pocket sphygmomanometer is that by the auscultation method the simplest, and at the same time the most accurate, method for obtaining blood pressure, the diastolic pressure is as easily and accurately obtained as the systolic pressure. Also being a mercurial instrument, it is more accurate and dependable than is possible with aneroids, which are, up to the present, the only other class of instruments that are of equal portability.

To close the instrument, cut No. 7, grasp the upper end of the manometer tube near the steel cap (N) and pull the tube and scale gently but firmly forward and fold down, as shown in cut No. 6. The steel clapper (H) will automatically close the upper end of the lower tube section. The lid will close by making firm pressure forward on its upper end. When it is closed a spring clip inside the end of the box engages and securely holds the clapper (H) in position, preventing the escape of any mercury. The entire apparatus measures 7″ x 2¼″ x 1½″ and weighs ten ounces.

When it is shut the instrument fits into the morocco-carrying case, the bulb and cuff alongside it, and, after the case is fastened, it will slip into the pocket.

Accuracy, the first essential, is obtained on this apparatus by a metal millimeter scale, especially compensated for any lowering of the level in the mercury reservoir; (2) by the zero (0) point on the scale being adjustable to the mercury level, so that the readings are not affected by climate and

temperature; (3) by the scale reading directly in millimeters of mercury, and being in a vertical line, makes reading much easier than where the markings are condensed and on a circular dial, as on the aneroids; (4) by reading directly in millimeters of mercury, the primary standard, it does not have to be checked up, as aneroids do; you are always sure of your readings; no spring aneroid diaphragms to weaken and delicately balanced needle accentuated by a hair spring; (5) by the use of a large column there is no separation of mercury, and oxidization and capillary errors are avoided; (6) by the use of a steel stopcock and flint glass no amalgam is formed with the mercury, so no friction; (7) by a steel needle valve there is a perfect air release.

The mercury remains clean owing to a new method of preventing powder from the rubber tubes being sucked into the mercury reservoir.

Portability: The entire instrument, pump, and cuff fit in a morocco carrying case which slips into the pocket.

Weight: So light that it can be carried in the coat pocket or in the hand bag.

Durability: (1) All parts are thoroughly protected by a metal case, not easily broken or deranged as aneroids are: (2) By a special stopcock no mercury can be lost: (3) By special stopcock (C) you have an additional safeguard should the rubber washer in the bulb leak slightly, until you can replace it with a new washer, the mercury can be absolutely maintained by closing the stopcock. This permits of using the arm band to produce Bier's hyperaemia. By inflating the apparatus to 50 to 60 mm. of Hg. and then closing the stopcock (A) you can maintain the pressure for any length of time desired. This is impossible of attainment on any apparatus not having this stopcock. This is the only pocket sphygmomanometer which has this special feature.

In addition to the above the apparatus is simple to operate, using a wide, soft cuff, and has an automatic catch on the lid which holds the instrument in the upright position when in operation.

It is as portable as an aneroid, with all the accuracy and dependability of the mercury column.

There are several other forms of accurate instruments, but owing to their expense and size they are not available in general practice, e.g., the Erlanger, Pachon, Uskoff, etc.

CHAPTER III

BASIC FACTORS ON WHICH BLOOD PRESSURE DEPENDS; DIASTOLIC AND PULSE PRESSURE; AND NORMAL READINGS

IN ORDER to utilize blood-pressure determinations, and make them of real value, it is necessary to understand on what they depend as well as what physiological factors are involved, and variations possible without pathologic changes.

While from a theoretic standpoint there are a large number of physiological factors to be considered, many of these do not, from a clinical standpoint, influence blood-pressure determinations to any great degree.

Blood-pressure Depends on Four Main Factors—(1) Cardiac strength. (2) Peripheral resistance in the vessels. (3)

The elasticity of the vessel walls. (4) The volume of blood.

Besides these there are several other factors, but they are not of great clinical importance, e. g., viscosity of the blood, etc.

The heart during systole, shortly after the beginning of its contraction, drives the blood out into the aorta. The pressure in the aorta then reaches the maximum, and shortly after the aortic valves close. The pressure from then on until the next systole is maintained by the elasticity of the vascular walls, and as the blood is being forced on through the capillaries, the pressure gradually falls, and reaches its minimum at the end of diastole.

The pressure depends mainly on the contractile power of the heart, and the peripheral resistance which it has to overcome, the peripheral resistance depending on the degree of contraction, or caliber of the vascular walls, and also on their distensibility.

The caliber of the vascular walls in turn

depends on the vasomotor center, the balance between vasoconstriction and vasodilatation, and its close interaction with the heart through its nerve supply.

As can be easily seen, the maximum or systolic pressure approximates the intraventricular pressure, while the minimal or diastolic pressure represents the peripheral resistance. The pulse pressure, or the difference between the two, represents the head pressure driving the blood on out through the arterioles e. g.

Systolic or maximum...150 mm. Hg
Diastolic or minimum...120 mm. Hg

Pulse pressure ..... 30 mm. Hg

The point to be especially emphasized is that the maximum or systolic pressure by itself indicates mainly heart strength, but equally, if not more important, the peripheral resistance is shown by the minimum or diastolic pressure, and the head of flow is shown by the pulse pressure.

In the past very little work has been done on diastolic and pulse pressure, a fact

due largely to the difficulty in obtaining reliable readings with the instruments available and the methods used, but this is no longer the case where the auscultatory method, already described, is utilized.

Discussion of Pulse Pressure and Diastolic Pressure.—Before going further it might be well to consider pulse pressure (the difference between systolic and diastolic readings) and diastolic pressure more in detail.

Various figures have been given for the normal range of pulse pressure:

Erlanger	30 to 40 mm. Hg
Hirschfelder	30 to 45 mm. Hg
Young	25 to 80 mm. Hg

It might be better stated by saying that the pulse pressure is 35 per cent. of the systolic reading where a normal balance is present; this gives the diastolic pressure as 35 per cent. lower than the systolic. While the correct diastolic pressure is at the time the second thumping sound becomes dull, the time when all sound disap-

pears may be much easier to obtain and will give readings 4-10 mm. lower, except in high pressure case when it may amount to from 8-16 mm. In cases of aortic regurgitation, patients with widely dilated arteries and children, the error may be even greater.

While Lauder Brunton says: "Diastolic pressure is to the systolic pressure, under normal conditions, as 3 is to 4." *This gives the pulse pressure as one-quarter of the systolic reading.* (This is not true when you used the auscultation method.)

He further states: "Diastolic pressure has as yet received comparatively little attention because of the difficulty of ascertaining it, yet it is a factor of great importance because by its amount and by the difference between it and the systolic pressure we obtain valuable data in regard to the strength of the heart and condition of the arterioles."

In substance he also gives the following:

Pulse pressure depends on the pulse rate. If the pulse is slowed more time is allowed for the blood to run through the

arterial system during diastole. Diastolic pressure will be lowered and pulse pressure increased. The reverse also applies.

A weak heart will not raise tension as rapidly as a strong one, and the time between the end of each systole and the next will be shorter, and the pulse pressure lower. In a stronger heart the interval between systoles is longer, and there is a larger pulse pressure.

Now turning to the blood vessels we find when contracting the diastolic pressure remains high, giving a small pulse pressure, and vice versa.

A low systolic pressure with a large pulse pressure shows dilated vessels and a probably strong heart.

A low systolic pressure with a slight pulse pressure indicates the heart itself is weak; in addition, there is probably some dilatation of the vessels, though a feeble heart with normal vessels could give these signs.

If there is a high systolic pressure, and a correspondingly high diastolic pressure, giving a normal pulse pressure, we may assume there is a normal balance be-

tween heart and vessels, and a compensatory condition is present.

Thus pulse pressure is of the greatest value in determining the condition present, whether mainly due to heart or arteries, and is most important in relation to treatment. By observing the changes in pulse pressure of our cases under treatment, we obtain the most accurate idea possible of the results that are being obtained; far more so than when we utilize the systolic pressure alone.

If the systolic pressure approximates the diastolic pressure, making a small pulse pressure, it is a clear indication of a failing circulation. This condition, if continued, would cause the systolic (maximum) and the diastolic (minimum) pressures to become the same, at which point there would be no pulse pressure and death would have taken place, as the cardiac strength, shown by the systolic pressure, would not be greater than the peripheral resistance, shown by the diastolic pressure, and there would be no circulation of the blood.

It is often of great importance to know not so much the pressure the blood is under when delivered to an organ, but rather the velocity of flow, so we can determine the amount of blood supplied. Here the pulse pressure determination is essential for *the velocity of the blood stream is roughly equal to the pulse pressure registered in mm. Hg multiplied by the pulse rate per minute.* While there are other factors present, and this is not absolutely correct in every case, yet in general this statement is correct, and gives us a very good idea of the amount of blood supplied to an organ. In general, a diminution of pulse pressure means a lessened velocity of the blood flow, pulse pressure being indicative of the head of flow.

Of all the material in this booklet I consider a clear conception of pulse pressure, its determination, application, and meaning the most important.

In the past many observers have been satisfied with the determination of systolic pressure alone, and wondered why their observations were useless in practical di-

agnosis and treatment; but now the reason for this discrepancy is made clear when we understand the obtaining of accurate pulse pressure and its interpretation.

The determination and application of pulse pressure in blood pressure work have changed the entire treatment and significance of the subject, so that now its application to general medicine is wide and of a practical nature, directing us to a right diagnosis, giving a prognosis and a means of carrying out practical and scientific treatment.

Blood-pressure readings without the determination of the diastolic pressure and the estimation of the pulse pressure are often very misleading, since they furnish but a partial estimation, whereas when determined they give invaluable information in numerous medical and surgical conditions.

Were the determination of the diastolic pressure any longer difficult there might be some excuse for not obtaining it and from it finding the pulse pressure, but by the

auscultatory method its accurate determination has been made so simple, being as easily and quickly determined as the systolic pressure, that there is no longer any reason for not utilizing it and obtaining the pulse pressure in every case.

The taking of accurate blood-pressure readings, being so simple, is destined in a few years to become a routine procedure in hospital and private work, taken and charted by the nurse just as at present is done in the case of pulse, respiration and temperature, and the diastolic and pulse pressure will be determined in every case in addition to the systolic pressure.

Normal Readings.*—Before turning to the consideration of blood-pressure under abnormal conditions, let us consider the normal variations, that have been determined by numerous observers.

It is well to bear in mind the fact that blood-pressure standards cannot be absolutely fixed, there being considerable variation in different individuals.

*Since this has been written I am glad to say one large hospital in Philadelphia has the nurses take auscultatory blood pressure readings, both systolic and diastolic.

	Age	Systolic	Diastolic
Erlanger	19 to 25 yrs	110	65 mm. Hg
Hirschfelder—All ages		115-120	75-85
Janeway—Before mid. life		100-130	25-40 mm. lower than systolic.
	After mid. life	130-145	25-40
	Before 2d yr.	75-90	
	After 2d yr.	90-110	

Normal—

Cook—Before 30 years 120-130
30 yrs. on 125-140

Abnormal—

Before mid. life pressure above ..... 145 mm. Hg
After mid. life pressure above ..... 160 mm. Hg

Low Limit—

Janeway—Male ..... 100 mm. Hg
Female ..... 90 mm. Hg

In general it may be stated that females are about 10 mm. lower than males.

The lowest blood-pressure readings, according to Hensen, were 40 mm. systolic, and lowest possible pressure with recovery was approximately 55 mm.

Cook and Briggs consider 60 mm. systolic severe.

Janeway, pressure below 75 mm. sys-

tolic rare except during operation, when it has reached 40 mm.

The lower limit represents the resistance of the arterioles, due to the necessary vasomotor tone, and is probably never less than 50 mm. mercury.

CHAPTER IV

PHYSIOLOGICAL VARIATIONS IN BLOOD PRESSURE

WHERE there are no pathological changes present, the following factors affecting the blood-pressure readings are found:

Location of Cuff.—It is important that the constricting cuff shall be on a level with the heart; otherwise the correct reading is raised or lowered by the effect of gravity on the column of blood, according to whether the constriction is below or above the heart level. If above, the readings will be too low; if below, they will be too high.

Position of Patient.—The position of the patient in relation to the horizontal is also important, systolic pressure being 8-10 millimeters higher in the reclining than in the sitting posture.

There is about the same difference between sitting and standing posture. The diastolic pressure also rises but relatively higher than the systolic, and as a result pulse pressure is decreased. The pulse rate is also increased. The main point is, therefore, to always take subsequent readings on the same patient, in the same posture, when possible.

Meals.—There is a moderate rise in systolic pressure and pulse pressure after meals, and the pulse rate is increased.

Breathing.—Deep and forced breathing raises blood-pressure during expiration, often as high as 10 mm., and lowers it during inspiration. Quiet breathing has no effect.

Sleep.—During sleep the maximum pressure is lowered 10 to 20 millimeters, due to relaxation and vasodilatation. The fall is most marked in minimal pressure.

Exercise.—Exercise causes a rise in maximum (systolic) pressure, and an increase in pulse pressure, the rate being also increased. If regular exercise is se-

vere, there may be a rise in blood-pressure of from 5 to 10 centimeters, depending on the amount of force exerted.

If exercise is carried to excess and fatigue ensues, blood-pressure falls, and the pulse rate is slowed.

Nervous and Mental Stimuli.—Pain, anger, emotion, and mental effort stimulate vasoconstriction, and cause a rise in blood-pressure, especially marked in minimal (diastolic) readings. The pulse is also quickened.

Mental work causes a marked rise in blood-pressure, especially when combined with worry and excitement, mental activity being roughly proportionate to the height of the blood-pressure.

As excitement and worry cause a very marked rise in blood-pressure they are often dangerous when the tension is already high.

Altitude.—Blood-pressure rises markedly with an increase of elevation. An elevation of 6,000 feet will give an average rise of 10 mm. On returning to a lower

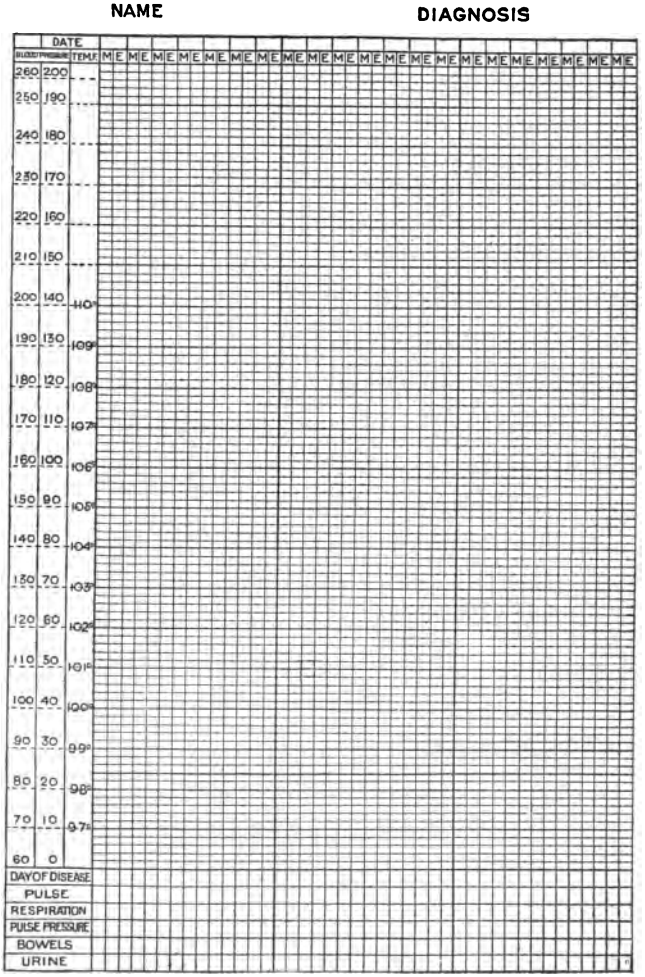

FIG. 8. —Nicholson's blood pressure and temperature chart much reduced; size 11¼ x 8½ inches.

altitude there is a gradual return to the former level, but the return is much slower than in cases of high tension due to worry, excitement, exercise, or mental strain.

Increased blood-pressure in high altitudes is due mainly to the increased heart action, from the rapid respiratory movements in rarefied air, but also to a minor degree to the cooler atmosphere which causes a constriction of the peripheral vessels, increasing the peripheral resistance, the increased amount of exercise taken, and the greater viscosity of the blood.

Cardiac Cases.—In cardiac cases caution must be used in sending patients to high altitudes.

(a) *In the young,* free from organic heart disease, simply worn out or convalescent, high altitudes are often beneficial.

(b) *In middle aged and elderly patients* use care, for if there are arteriosclerotic changes or the heart is damaged, high altitudes are dangerous. Apoplexy or cardiac dilatation may ensue as the reserve force of both vessels and heart is lacking.

In Phthisis.—Here high altitude is mainly important in relation to hemorrhage. In the young, where the arteries are resilient, there is little danger. In middle-aged there is a real risk, and if the blood-pressure is elevated do not send to a high altitude.

Time Consumed in Taking Readings.—If constriction is continued over the vessel for one minute you may get a possible rise of 5 mm. Hg. Continued compression may cause a rise up to 20 mm. In myocarditis a lowered pressure results.

Summary.—Take all readings on the same patient at the same time of day, preferably midway between meals. Have the patient in a comfortable position, with muscles relaxed, best reclining, but in any case make all subsequent observations in the same position. Exclude all excitement, and see that the patient is mentally composed, and breathing quietly. Make the determinations as rapidly as possible.

If the above precautions are observed, from a clinical standpoint there will be no

important error in the pressure values, providing the apparatus is accurate, and the auscultation method properly employed.

Blood-pressure is also affected by two pathological conditions, not in themselves diseases:

(1) *Edema.*—Here the reading may be too high, due to the pressure required to squeeze the fluid out of the tissues. Hensen reports in one case an error of 20 mm. Hg.

(2) *Asphyxia.*—In this condition we often obtain an extreme rise of pressure and, in slighter grades of deficient oxygenation of the blood, a rise to a less degree. This condition must be considered in diseases of the lung, laryngeal diphtheria, etc.

CHAPTER V

HYPERTENSION

CONSIDERING hypertension, we find that where it is not due to the factors we have just considered, or secondary to drugs, as digitalis, adrenalin, strychnia, ergot, etc., there is an increased peripheral resistance in the blood vessels, which has been found to depend largely on the splanchnics.

Another important point is the fact that continued high pressure cannot be maintained without cardiac hypertrophy, and that the increased tension will of itself cause changes in the vessel wall, thickening of intima and media, and loss of elasticity, with danger of rupture.

Cases of hypertension are rapidly becoming more frequent, due, in large extent, to the increasing stress and strain of

business life and the associated conditions of overindulgence in food, especially protein; too rapid eating; the drinking of too little water; too little healthful exercise; the keeping of late hours, with lack of the proper amount of sleep; the use of undue mental effort; and the excessive use of alcohol, tea, coffee, and tobacco. In a word, lack of good hygiene.

Hypertension is often in the beginning primary and purely a spastic condition prevailing in the arterial system unaccompanied by organic changes in the vessel walls, the preliminary stage of a generalized arteriosclerosis.

It is important to discover these causes of hypertension early, as they determine the onset of a condition which, if continued, will cause serious and permanent changes in the vessel walls, which in turn produce cardiac hypertrophy, with its subsequent weakening, followed by failure of compensation. These spastic cases are nearly all due to a toxemia and can be relieved by proper regulation of the bowels,

diet, and mental and physical work. In this connection the importance of routine blood-pressure determination is evident in showing a condition which would otherwise not be known until the patient were forty or past and permanent damage to the vascular walls had taken place, sufficient for symptoms to develop and cause the patient to consult a physician. By routine examinations these cases would be detected at their onset and damage prevented by proper prophylaxis.

Even after organic changes in the arterial system have been caused there is still in most cases some spasm, by the relief of which great benefit may be derived, and the development of more vascular changes prevented.

The treatment of hypertension in detail will be considered more fully at the end of this section.

It might be well now to turn to the conditions in which hypertension is associated with pathological conditions and not a primary condition in itself.

Angiosclerosis (Dr. T. C. Janeway).—"Angiosclerosis" describes a rather common class of patients who have a permanent high blood-pressure with no signs of sclerosis or nephritis, even after repeated examinations.

These cases Janeway considers are early chronic interstitial nephritis.

Their discovery is very important in order to prevent cardiac hypertrophy and vascular changes, which are inevitable if the condition of high tension is not relieved.

Treatment.—Here it is important to regulate the diet, eliminate as far as possible overwork and worry, keep the intestinal tract open, and the bowel function active, as many of these cases are due to a certain amount of auto-intoxication. Sweating is also of value.

Caution.—Do not use vasodilators until all other methods fail, or the pressure is such that it demands immediate relief, there being danger of rupture of the ves-

sels; then use nitrates, and if necessary bleed.

High blood-pressure is often compensatory and by lowering it harm is done.

Angina Pectoris.—There are a large number of patients complaining of mild angenoid symptoms, tightness under the sternum, dyspnea on exertion, and belching after meals, which are accompanied by high blood-pressure.

These are cases of mild angina pectoris.

"Given angenoid symptoms with marked hypertension (systolic 180 mm. or over), you are probably dealing with angina pectoris." (Janeway.)

The reverse of Dr. Janeway's statement, however, does not follow, for while in a number of cases there is an associated arteriosclerosis of the aorta and coronary arteries, with a high arterial tension, in many cases there are marked attacks of angina pectoris without increased blood-pressure. No less an authority than Dr. James Mackenzie considers that blood-pressure is normal or lowered during the

attack, for he says: "I can only infer that cases of arterial spasm are very exceptional and their description fostered by the relief obtained by the administration of amyl nitrite has given a wrong conception in regard to the condition inducing an attack of angina pectoris. I have found during the attack the pulse becomes small, soft, and scarcely perceptible, from weakness of the heart, the heart sounds becoming very faint. I have also found an acceleration of the heart rate. I could detect no change in the heart or arteries, and there never was the slightest enlargement of the heart coming on during the attack."

Dr. William Osler gives a good summary of this subject when he says:

"The pulse tension, however, is usually increased, but it is surprising, even in the cases of extreme severity, how slightly the character of the pulse may be altered."

Arteriosclerosis.—Here our diagnosis of the existence of sclerosis rests on the palpation of the hardened vessel walls,

visible tortuosity, or we may reason it is present from the sclerosed vessels in the eye-ground, the enlarged left ventricle, the ringing aortic second sound, with high blood-pressure.

Numerous observations have shown that unless the splanchnic vessels or the aortic artery above the diaphragm are affected there are not likely to be an increased blood-pressure and hypertrophy of the heart, but whenever the splanchnics are sclerosed the blood-pressure is elevated.

In this condition the systolic pressure is greatly increased (159-170 mm. to 250 mm.). The diastolic pressure increases (110-130 mm.), but not proportionately, thus increasing the pulse pressure greatly (60 mm. or over).

We cannot assume that where there is a high blood-pressure without tangible organic lesions we are dealing with arteriosclerosis, as not all cases of arteriosclerosis raise tension, and certain other factors have also to be considered as:

(1) Pain, mental and nervous excite-

ment, etc., mentioned under physiological factors (page 40).

(2) Drugs, e. g., nicotine, which by its direct effect on the arterial wall raises tension, though where long continued it lowers tension, owing to its toxic action on cardiac muscle.

(3) Such conditions as asphyxia and edema.

(4) In addition there are certain toxic conditions of increased internal secretion as where the adrenals or pituitary bodies are overactive, in which case the tension might be high without any sclerotic changes being present.

While the rôle of primary arteriosclerosis in causing high blood-pressure is limited, being associated with hypertension in only fifty per cent. of the cases (where the generalized sclerosis affects the splanchnics or the aorta above the diaphragm), hypertension, no matter what its source may be, if continued, causes changes in the vessel walls producing marked sclerosis and cardiac hypertrophy.

Arteriosclerosis as a result of continued high tension of course is accompanied by a high blood-pressure, but in arteriosclerosis due to the toxine of infection often the blood-pressure is normal or if raised it is later in the process. Pure senile arteriosclerosis has no associated hypertension.

Dr. R. D. Rudolph says: *"It is safe to argue in cases of arteriosclerosis with increased pressure that the relative difference between the systolic and diastolic pressures (pulse pressure, auth.) would be a measure of the degree to which the increased pressure was due to the sclerosis of the arterial tract between the heart and the point at which the pulse is being felt."*

There is no way of diagnosing cerebral arterial degeneration absolutely from the general blood-pressure, but the probability of its presence should be borne in mind where there is superficial sclerosis associated with a moderate elevation of blood-pressure.

Sir T. Clifford Albutt, in speaking of this subject, lays down the rule that every

individual over forty should have blood-pressure taken every four or five years, that he may know if there is a tendency to arteriosclerosis, the presclerotic stage being noted long before the heart is affected.

In conclusion, I wish to call attention to two important points: (1) That arteriosclerosis is often so closely associated with diseases producing high tension, as nephritis and cardiac conditions, that the hypertension present in such cases is due to the associated disease and not to the arteriosclerosis. These diseases will be considered under their separate heads.

(2) There is a class of patients who have had a high arterial tension, but owing to a marked myocarditis and, in some cases, cardiac dilatation, resulting from the continued high tension, the high systolic pressure in the early stages becomes about normal in height, or even a little lower than normal. These cases are more serious than those in which the tension remains high, as they show that the com-

paratively high tension can no longer be maintained by the heart. Many serious mistakes have been made by considering such cases as in good health because the systolic pressure is about the normal level or lower. These cases can easily be diagnosed if the diastolic pressure be taken as well as the systolic, for, while the heart muscle cannot maintain the systolic pressure, the peripheral resistance in the vessels, due to the sclerosed condition of their walls, remains and maintains a relatively high diastolic pressure, giving a small pulse pressure.

The treatment of this condition will be considered under hypertension.

Autointoxication.—Here is often found a markedly elevated blood-pressure, but in some cases where there is marked constipation the pressure may be low.

As Dr. W. H. Sheldon aptly puts it: "Headaches and dizziness supposed to be due to high pressure I have again and again seen disappear with laxatives and diet and no change in the blood-pressure.

Most of the cases given above had increased indican in the urine, and I am inclined to believe that the headaches and dizziness are due more to intestinal putrefaction than high pressure."

Diabetes.—In this disease blood-pressure determinations are of no value from either a diagnostic or prognostic standpoint, as the disease only affects the height of blood-pressure when complicated by other conditions, e. g., arteriosclerosis. When there is a marked acidosis there is a rather marked rise in blood-pressure proportionate to the degree of acid intoxication.

Drugs.—Here will be mentioned briefly only those drugs which produce hypertension, those reducing arterial tension being mentioned under the treatment of hypertension.

Briggs and Cook, in an extensive series of experiments at the Johns Hopkins Hospital, obtained some very valuable information as to the blood-pressure-raising value of drugs, finding:

Adrenalin, when administered intravenously, raised the blood-pressure to any desired height, but was transitory.

Cocaine in post-operative low tension and in hemorrhage given in doses of ¼-½ a grain, hypodermically, produced an almost immediate rise in blood-pressure of 10 to 20 mm., which was maintained 1 to 3 hours.

Camphor proved generally inert. In weakened cardiac systole and in acute toxic cardiac dilatation, it produced good results, but the same conditions were amply covered by strychnia and digitalin.

Digitalis, when given as digitalin hypodermatically, was more certain to raise the blood-pressure than strychnia, its action was manifest earlier, reached a maximum sooner, but the action was not so long maintained. Given in doses of 1-20 to 1-10 of a grain hypodermatically, digitalin often caused a rise when strychnia failed, blood-pressure being maintained by a combination of the two.

Normal saline solution was found of little value in cases of shock, unless there was added ¼ to ½ a grain of cocaine, or 10 minims of adrenalin to the intravenous injection.

In hemorrhage, when the bleeding point had been secured, the saline solution raised the blood-pressure, by increasing the volume of the blood, and was found very valuable.

Strychnia in doses of 1-60 to 1-10 of a grain raised blood-pressure, and its effect was maintained from one to four hours. After eight to twelve doses there was no further rise, but if one or two doses were omitted the pressure fell, but could be raised again by renewed administration of the drug. "On the whole, strychnia is by far the most satisfactory cardiovascular stimulant for long continued routine administration." Doses of 1-20 to 1-10 of a grain hypodermatically produced a quick response, raising the blood-pressure 80-100 mm. A dose of 1-20 of a grain often gives

a 40-mm. rise, lasting one hour. When the pressure begins to fall it may be maintained by a smaller dose.

Among other drugs which elevate blood-pressure are:

Atropine, increasing both cardiac energy and peripheral resistance.

Pituitary extract ("Vaparole") 1 c. c. twice daily gives a marked and sustained rise, but causes severe symptoms, and at the present writing is not a safe drug to use in reduced blood-pressure.

Caffein, in the form of the citrate, 10 grains three times a day, is very efficient, and is next to pituitary extract in the strength of its reaction. Caffein must not be used in tea drinkers.

Tea and *coffee* both produce a transitory rise. Subjects who indulge freely often have a high tension, which leads to arteriosclerosis.

Ergot produces a slight elevation of blood-pressure due to its vasoconstricting effect.

Epilepsy, Idiopathic.—It is associated

with a slow pulse and a high blood-pressure, which falls with the termination of the attack, the fall of the high blood-pressure being an aid in the differential diagnosis of the post-epileptic state and uremia, as in the latter there would be a maintained pressure during coma.

Exophthalmic Goiter.—Blood-pressure is variable, but as the disease is often accompanied by a hypertrophied heart, the systolic pressure is often raised, e. g.,

Systolic	140-160 mm. Hg
Diastolic	90-110 mm. Hg
Pulse pressure	30-50 mm. Hg
Pulse rate	120 or more

Eye Diseases.—In diseases of the eye high arterial tension plays a very important rôle, and the determination of blood-pressure is very valuable in the diagnosis, prognosis, and treatment of many ocular conditions.

The routine determination of blood-pressure in such cases is imperative, for by means of it many cases of high blood-pressure are discovered and corrective treat-

ment instituted before any extensive ocular changes have taken place.

It is now well recognized that a high arterial tension, if maintained, no matter from what exciting cause, will produce sclerotic changes in the walls of the arteries, affecting the general vascular system (see hypertension), and the vascular system of the eye being part of the peripheral circulation is also affected.

Not only is the determination of high blood-pressure in relation to eye diseases of importance to the oculist but also to the internist and general practitioner, for when the general practitioner discovers he has a case of high arterial tension he should think of the possible conditions which might result from such hypertension, not only to the general circulation, but also to the special organs of the body.

In many cases by consulting with a competent oculist at once the patient may be saved much damage to the eye by the immediate adoption of corrective measures.

The following are the most important

ocular conditions in which increased blood-pressure is significant:

Spasm of the Retinal Vessels.—There are a number of patients with temporary unilateral blindness, sudden in onset, and lasting from ten minutes to half an hour. Both eyes may be affected, but not at the same time.

In a few of these cases, where the patients could be examined during an attack, the ophthalmoscope showed a blanching of the retinal vessels, due to the arterial spasm, disappearing when the attack terminated. These attacks were invariably associated with high arterial tension, and under proper treatment directed to the lowering and maintenance of a normal blood-pressure such cases do well and often are prevented from developing actual sclerotic changes in the vessel walls. Even if treatment is not instituted until late in the course of the disease, further damage can often be prevented, but the important point is to discover the condition early, while it is purely an arterial

spasm without any actual arterial change.

Untreated, these cases are followed by marked sclerotic vascular changes, and in many thrombi and emboli are formed, with all their serious and lasting effects.

Cataract.—In this class of cases there are so many sclerotic changes (the cataract being part of a general sclerotic process), high tension is almost universal. Most ophthalmologists do not consider that the sclerosis present contraindicates cataract extraction, but these cases often develop a post-operative intraocular hemorrhage due to the arterial hypertension, with resulting blindness.

By a determination of the blood-pressure before operation and the institution of preparative treatment, i. e., such as bleeding, etc., the arterial tension may be lowered and subsequent intraocular hemorrhage prevented. A bleeding of from eight to sixteen ounces lowers the blood-pressure markedly, the amount required being determined by the sphygmomanometer readings, and as the tension re-

mains low for several days, it gives the eye time to become accustomed to its new condition and intraocular hemorrhage is thus prevented.

Chronic Interstitial Nephritis in Relation to the Eye.—This subject is very clearly treated by Dr. Luther C. Peter when he says: "In chronic interstitial nephritis more or less direct relation between the height of the tension and the severity of the symptoms is observed, modifying influences being age, degree of arteriosclerosis, the duration of the high tension and the individual resisting power.

"Other things being equal, the amount of retinal disease will be in proportion to the height and duration of the increased tension.

"Increased blood-pressure is one of the earliest premonitory signs of arteriosclerosis and chronic interstitial nephritis, and possibly acts as a causative factor, and second that arterial hypertension is the cause of early retinal and arterial changes as well as later phenomena."

Glaucoma.—Hypertension is now considered by the majority of ophthalmologists to be the probable causative factor in cases of glaucoma.

Hypertension is invariably present and affords a very valuable means of diagnosis as also indications as to treatment.

Retinal Hemorrhage.—Retinal hemorrhage of non-traumatic origin is due to increased blood-pressure.

Dr. Peter, in a review of this subject, gives the following summary:

"Arterial hypertension is the chief cause of eye ground phenomena observed in chronic interstitial nephritis and arteriosclerosis.

"Senile vascular changes, associated with high blood-pressure, may be observed at times, before these diseases are diagnosed by other clinical symptoms.

"It frequently acts as a cause for subconjunctival hemorrhage and is so closely associated with glaucoma that it should be regarded as an active factor in the development of the disease.

"It probably will help to explain the phenomena of intraocular hemorrhage after cataract extraction.

"In order to prevent and to treat rationally the more serious eye conditions routine blood-pressure studies should be made in all cases of intraocular disease not traumatic."

Gout.—Gives increased tension both during the attack and between attacks, when arterial changes are marked.

Heart Disease.—This subject will be treated under its several divisions as the different forms of cardiac disease are fairly well defined. Angina pectoris has already been treated under a separate head so will not be mentioned here.

Aortic Regurgitation.—Here is found a systolic pressure 75 to 100 per cent. higher than the diastolic, the pulse pressure being very high. In some cases 120 to 130 mm. systolic, diastolic, 50 to 60 mm., in other cases often 170 to 220 mm. systolic, diastolic 60 to 140 mm.; but in all cases the pulse pressure is great.

When you auscult over the artery in taking the blood-pressure reading you often note a continuance of sound (an aid in diagnosing this condition), so that the diastolic pressure has to be determined by palpation in severe cases.*

In well compensated cases sound does disappear.

Dr. Leonard Hill showed that blood-pressure is about the same in both brachial and femoral arteries, but in aortic regurgitation the readings from the femoral are much higher.

When the relation of pulse pressure to the diastolic reading is low, it is not likely that there is aortic insufficiency.

Chronic Cardiac Hypertrophy.—Here we have an increase in both systolic and diastolic pressure (systolic 140 to 160 mm., diastolic 90 to 110 mm. Hg).

Cardiac Valve Lesions Other than Aortic.—Blood-pressure in these cases is normal when compensation is good.

*Now that the time the second thumping sound becomes dull is established as the correct diastolic pressure, the minimal pressure (diastolic) can be easily obtained by the auscultation method.

Heart with Loss of Compensation and Asthma.—Here is found high tension from associated asphyxia: when severe, actual edema of lungs takes place and life is in danger, the blood being loaded with carbon dioxide, e. g., bleeding, amyl nitrite, nitroglycerine, and later, after acute condition is relieved, cardiac stimulants.

Myocarditis.—There are many cases of myocarditis not discoverable by physical examination either because of their slight degree or because in fat subjects with large chest walls clear physical signs are impossible to obtain. It is in these cases that blood-pressure helps not only to make the diagnosis but also to determine the extent of the disease.

Myocarditis and a good general idea of its extent can be determined by means of a functional test devised by Graupner.

Take the pulse rate and the blood-pressure of the patient to be tested and then give a prescribed amount of exercise, as walking up a certain number of steps, etc., then take the pulse rate and the blood-pres-

sure every five minutes. A normal heart will, during exercise, cause a rise of blood-pressure associated with an accelerated pulse rate.

The blood-pressure and the pulse rate will remain elevated during the exercise unless it is excessive or unduly prolonged. With a cessation of the exercise both blood-pressure and pulse will, in a short time, return to their previous level, the pulse rate a little before the blood-pressure.

In myocarditis cases, if mild, there will be an elevation of blood-pressure and an acceleration of the pulse rate, but the blood-pressure in a short time will fall below or to its previous level, while the pulse rate remains high longer. In some severe cases the blood-pressure will fall from the start, the pulse rate increasing, the blood-pressure rising to its previous level only after a long time.

In addition there are myocarditis cases of large, weak hearts with dyspnea, edema, and subjective symptoms:

(1) With hypertension.

(2) Without hypertension.

(1) These are cases secondary to Bright's disease or arteriosclerosis, or are primary myocarditis cases which have developed Bright's.

(2) These are primary uncomplicated cases of myocarditis or in the terminal stage of the secondary type.

The primary cases usually show a high normal blood-pressure, and are more liable to have edema (systolic 135 to 145 mm. Hg).

Acute Endocarditis.—It is associated with a low systolic pressure.

Bradycardia.—Here the pulse pressure is increased.

Cardiac Arrhythmia.—There are many cases of arrhythmia purely functional in character, but there are also a number with true organic disease. It is in these doubtful cases that blood-pressure determinations are of great value.

In discussing physical diagnosis Dr. Richard C. Cabot says:

"On the other side are irregular hearts which you finally believed to be merely functional in origin and to have no immediate significance, because the blood-pressure is normal. An irregular heart plus a high blood-pressure is serious. The very same heart with low blood-pressure may be of no significance."

Dr. Cabot further makes this statement about cardiac cases in general: "Patients, the examination of whose hearts does not show anything certainly characteristic of disease, have often been shown to be diseased, or proven later to be diseased, by the high blood-pressure registered by the machine, *pressure which my fingers are not able to detect in feeling the pulse at the periphery.*"

Increased Intracranial Tension.—*Apoplexy, Depressed Fracture of the Skull, Fracture of the Base, Jacksonian Epilepsy, Intracranial Hemorrhage, Tumors, (rapid growing cerebral).*

In these conditions of increased intracerebral pressure the highest blood-pressure readings occur. Hirschfelder gives

Systolic.....300–400 mm.
Diastolic.....160 mm. or over
Pulse slowed.

The high pressure is compensatory and is the effort to supply more blood against the increased intracerebral tension and thus prevent anemia of the brain.

The important point is not to bleed, and try to lower the pressure, but to operate where possible, and where not, to give atropine to paralyze the vagus, and to allow the pressure to rise more rapidly.

In a case of head injury the blood-pressure reading is of great value; for in concussion the pressure is low, whereas in the above-named conditions it is invariably high, unless very late when cerebral paralysis has developed.

Nephritis. *—In nephritis, especially in the chronic forms, blood-pressure determinations are one of the most valuable means of diagnosis. Dr. Richard C. Cabot

* In cerebral thrombosis the pressure is normal, or at least but very slightly elevated, easily distinguishing these cases from true apoplexy. In cerebral thrombosis symptoms are often relieved and cases cured by giving strychnine and stimulants.

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says: "Then calling your attention to the early diagnosis of kidney lesions, I see a good many cases of renal disease entirely free from albuminuria or from casts, but with high blood-pressure, which are shown later, post mortem, to be renal disease. These cases could not have been suspected to be renal disease except by blood-pressure. In other words, I regard the blood-pressure measurements as of more importance than the examination of the urine in chronic kidney trouble. Examination of the urine has again and again led me astray, the measurement of the blood-pressure almost never."

(A) *Chronic interstitial nephritis* gives a high systolic pressure (200 mm. or higher), and a relatively low diastolic pressure; giving a large pulse pressure (60 to 80 mm. Hg).

Here hypertension is one of the most important signs, often making the diagnosis in obese individuals, where the enlargement of the heart is hard to define and the urine negative for a long time.

Dr. T. C. Janeway says: "Given a systolic pressure of over 200 mm., the diagnosis of contracted kidney must be disproved by repeated examinations before it is abandoned."

Caution.—If the heart has failed to compensate, the pressure may be low, and it is here that the pulse pressure will aid materially.

In this condition the pulse pressure is lessened.

The prognosis depends not so much on the actual height of the mercurial column as on a pressure which is rising or resistant to treatment. The ultimate danger is rupture and apoplexy.

(B) *Chronic Parenchymatous Nephritis.*—In it the blood-pressure is uncertain, often being normal. When there is hypertension it often aids, but its absence does not negate the diagnosis.

(C) *Acute Nephritis.*—The pressure varies greatly, in typhoid fever and pneumonia there being no increase in tension.

In scarlet fever, however, there is a sharp, sudden rise, often of 50 mm., and it is a valuable aid in the diagnosis.

(D) *Uremia.*—Here blood-pressure runs parallel with the symptoms, maximum pressure being very high, in some cases 290 mm. Hg.

Pressure falls with the alleviation of the symptoms as a general rule, though it may fall before fatal termination, due to failure of the heart.

Obstetrics and Eclampsia, etc.—Most authorities agree that at the end of pregnancy there is normally a rise in systolic blood-pressure (10-15 mm. Hg) with little change in the diastolic pressure; although Starling, who reported the results of cases over a five-year period, believes the blood-pressure remains normal.

A fact recognized by all authorities is that the toxemia of pregnancy in the latter months is accompanied by a rising blood-pressure, and that it is often present some time before any other signs or symptoms.

In pregnancy the following figures have been given:

Normal cases—

Starling—Systolic pressure	110-120 mm. Hg
J. C. Hirst—Systolic pressure up to seven and one-half months.....	118 mm. Hg
Systolic pressure mid. last month..	124 mm. Hg

The whole subject is well summarized in a paper by Dr. J. C. Hirst, in which he says:

"1. Normal blood-pressure in the non-pregnant is 112 mm.

"2. Normal blood-pressure in the healthy pregnant is 118 mm. In the last month slightly higher.

"3. Blood-pressure in toxemia in the first half of pregnancy associated with pernicious vomiting is invariably low.

"4. Blood-pressure in the toxemias in the latter half of pregnancy associated with albuminuria and eclampsia invariably high.

"5. High and rising blood-pressure is an invariable and early, often the earliest,

sign of toxemia in the latter half of pregnancy.

"6. Upon rupture of the membranes there is an immediate fall of pressure 60-90 mm. This fall is temporary only, but is attended with marked relief in the headache and epigastric pain these patients so often complain of.

"Relief lasts for some hours during which there is a gradual return to the previous level.

"7. There is a second fall, 60-90 mm., after the child is born. This again is temporary, and is 15-30 mm.; if the patient has not bled profusely, then the pressure is back to somewhere near the previous level before birth.

"8. Usually blood-pressure is high for 48 hours after birth, then begins to subside and reaches normal, 118-124 mm., in seven to ten days.

"9. A blood-pressure below 125 mm. should be disregarded; 125-150 mm. needs careful watching and moderate eliminative treatment.

"Over 150 mm. needs active eliminative treatment, and probably will, especially if there is a tendency to climb higher, require induction of premature labor."

Starling, in treatment, advocates before using more drastic methods: Rest in bed on a carbohydrate and milk diet, with one teaspoonful of bicarbonate of soda four times a day, with four pints of liquid and thyroid extract in sthenic cases.

The blood-pressure remains high after delivery and the relief of toxemic symptoms, whenever there has been a previous nephritis. Hypotension also is important after delivery, in relation to the question of hemorrhage and shock, being markedly lowered in both conditions. This is especially important in relation to treatment. The question of whether the pressure is stationary, progressively rising or falling, and its relation to treatment are of more importance than absolute figures, though the latter serve as a good guide.

Plumbism.—Both acute and chronic cases show a well-marked high tension.

In doubtful cases, where there is high tension, examine for signs of plumbism.

Treatment of Hypertension.—Hypertension is a symptom and not a disease, and its treatment, like that of any other symptom, is that directed to the cause. At the outset it should be clearly borne in mind that in a large number of cases hypertension is a necessary compensatory process in order to maintain a correct cardiovascular equilibrium. This is especially true in advanced cases where marked vascular changes have taken place and the condition is beyond the spastic stage. Where the causation of hypertension cannot be removed we often, instead of lowering blood-pressure, best conserve the interests of our patients by maintaining the tension.

Prophylaxis.—Prophylaxis is most important and will become more and more frequently used as the routine taking of blood-pressure becomes more prevalent.

Many cases of hypertension will be found before there are any symptoms at-

tributable to it or any organic changes in the blood-vascular system. In other words, it will be discovered in the spastic stage.

Dr. L. G. Visscher, in a paper on the treatment of chronic hypertension, gives a very good presentation of this subject. He says in substance:

We should warn our patients against a chronic overindulgence in food, more especially in food having a large nuclein content which tends to form excessive purin compounds, which are marked elevators of blood-pressure, e. g., meats, kidneys, liver, sweet-breads, caviar, cured meat, sausage, gravies, old cheese broth, mushrooms, peas, veal, etc.

Equally important is to emphasize proper mastication and slow eating; the avoidance of excessive muscular exercise, without gradual training, but the importance of moderate exercise in the open air; the avoidance of late hours without the proper amount of sleep, and the overindulgence in coffee, tea, tobacco, and alcohol;

the value of water drinking; and the elimination of excessive mental work and worry and the abstinence from exciting and highly stimulating amusements.

Now, turning to the treatment of a patient who comes to us with symptoms of hypertension, or one in whom we discover the condition during routine examination, certain factors are of great importance in determining the treatment to be given:

1. Age of the patient. Those around forty years are treated quite differently from those of sixty.

2. Is the hypertension part of an acute process or a chronic one? If chronic, how extensive are the sclerotic changes?

3. Is the blood-pressure sufficiently high to cause immediate danger of apoplexy or cardiac dilatation?

4. What is the condition of the myocardium?

5. Is the hypertension primary or secondary?

All these questions cannot be answered at once, and some can only be determined

after long study, but there are certain lines of treatment which we can institute at once, which aid us in a diagnosis and at the same time benefit our patient.

Here I shall again quote in substance from Dr. L. G. Visscher:

Our first task is to determine the food intake of our patient and limit it as to quantity, but more especially as to the nuclein foods mentioned under prophylaxis, for the formation of purin compounds produces marked hypertension. Here it is important to estimate the indican, urea, and acidity of the urine in order to determine the proteid tolerance of these cases. An excessive nuclein food causes an acidosis and the carbonic acid is retained in the blood and not given off so freely from the lungs. As carbonic acid has marked pressor effects, the tension is elevated. By cutting down nuclein foods to their point of tolerance and giving plenty of vegetables and fruit the acidosis is prevented and the tension lowered. Care must be used in old subjects as they

are accustomed to and need a higher proteid food; dieting in these cases often causes cardiac weakness and severe symptoms.

As Dr. Visscher says:

"One routine way is the administration of alkaline laxatives, since it has been demonstrated that alkalinity of the intestinal contents increases putrefaction and since the products of this process have high pressor qualities, it is better to give non-alkaline laxatives, when indican is abundant in the urine.

"I have found it of distinct benefit in cases in which introduction by mouth of alkali increases flatulency to administer it by rectum once or twice a day.

"A frequent coeffect of laxative medication is the hurrying of albumoses into the realm of the colon bacillus, which thrives on albumoses and does not subsist on peptones; therefore it is our task to give laxatives early before breakfast or well after the height of digestion.

"Next it is important to determine

whether we are dealing with a case of hypertension with increased intraabdominal tension. This condition is clinically manifested by: Slight dyspnea, moderate hypertension, aching limbs, torpid liver and catarrhal gastritis."

The causes are:

"Abundant food.

"Gorged liver.

"Chronic loading of a distended colon.

"Gas in the stomach and colon.

"Omental fat."

These conditions he treats by regulation of the diet, use of laxatives in the morning, warm enema in the evening, carminatives and massage of the abdomen.

"In dealing with general obesity or more local embonpoint, a good deal of caution is needed; not so much at the disappearance of fat do we aim as at the timely prevention of its formation. When the abdominal parietes have first been comfortably filled for years, and thereafter uncomfortably stretched for some more years, the intra-abdominal circulation

adapting itself more or less to it in the meanwhile, what will happen by energetic under-dieting and massaging? Though the diaphragm will be greatly freed in its excursions, the flabby abdominal wall will give insufficient support and a tendency to allow intra-abdominal pressure will be manifest with a hindrance to expiratory excursion. This low intra-abdominal tension, accompanied by a feeling of exhaustion and early fatigue in our advanced hyperpietics, is a far more difficult matter to deal with. The inferior cava output is retarded and the venous splanchnic area remains gorged, with flatulence and indigestion as a result, only compensated for by a rise of pressure in the splanchnic arteries, thereby throwing back the work on the already overburdened heart. So, in a measure, we should endeavor, in spite of hypertension, to overfeed our lean patients, not forgetting that many thin people, when hyperpietic, are often big eaters and mysteriously powerful alcohol absorbers."

Then taking up exercise, bathing, and sleep, he says:

"Within bounds of reason an ample amount of outdoor exercise is beneficial. I emphasize a one or two-mile constitutional before retiring, depending on the heart's tonicity and reserve force.

"Warm bathing is very beneficial, both morning and evening, with a cold sponge or shower thereafter.

"As to hours of sleep, it should be better understood that carbonic acid is of high pressor power, that sleep in ill-ventilated rooms will interfere with metabolism during one-third of our lifetime, a time additionally spent in the digestion and assimilation of the heaviest meal of the day. Invariably, for reasons already given, people with hypertension would better eat light evening meals, with ease thereafter for a few hours, then take a moderate amount of physical exercise, a warm bath, perhaps a warm enema, and sleep in a warm bed with the windows wide open." If having tried the methods just mentioned

the desired result is not obtained we may then turn to various modes of treatment, as drugs, etc.

The benefit to be derived is in proportion to the amount of vascular spasm present, it being remembered that even in markedly sclerotic cases there is usually some arterial spasm present.

The first to be mentioned are the iodides. Dr. J. Mackenzie states that nitrites are of little avail, as their action is too transitory. In cases of high tension with discomfort, as pain and tightness across the chest, he uses potassium iodide in five-grain doses four times a day, and finds that it often relieves the symptoms, but quite often does not lower the tension, though marked benefit is shown. (One point is to be borne in mind, careful observation of the patient to see that he does not develop thyroidism from the iodine given.)

Dr. Mackenzie also advocates chloral hydrate given in five-grain doses two to three times a day, as well as in larger

doses to produce sleep. This is especially beneficial in cases of angina pectoris.

When there is a marked arteriosclerosis very little can be done to reduce tension; the only means that would produce a marked effect is by bleeding the patient, but the result would be temporary, called for only when there was danger of apoplexy or dilatation of the heart. Many of these cases, however, can be much benefited by proper hygiene to eliminate what spastic condition is still present and further can be made comfortable by small doses of the iodides. The iodides are of especial value in sclerotic cases due to syphilis.

Cases of psychic hypertension from mental work and worry, in addition to the regulation of diet, exercise, etc., are often greatly benefited if put on fairly large doses of bromides for a week or so and also if given chloral, medinal, veronal, etc., to produce sleep. In addition a twenty-minute rest after meals will be found very beneficial.

In senile hearts with hypertension it is of great value to give digitalis, combined with a nitrite or iodide, as in these cases the high tension is the result of a venous stasis and a better action of the heart relieves the symptoms and lowers the tension.

In very marked cases of hypertension sometimes the use of absolute rest, massage and a milk diet will produce a good result; in many a reduction in pressure may be very rapidly attained by the use of an exclusive cereal diet (cooked cereals), farina, cream of wheat, grits, rice, etc., especially where there is much intestinal fermentation and an acidosis present.

Here it might be well to mention the fact that in some cases it is beneficial to limit the amount of the salt intake as sodium chloride causes vasomotor spasm and is hard to eliminate.

In the *toxic group* of cases active purgation with blue mass or calomel and the use of hot-air baths are most effective.

Acute toxic cases associated with dila-

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tation of the heart are best treated by venesection, the amount being determined by the sphygmomanometer readings.

In the hypertension of the toxemia of pregnancy aconite in two-drop doses is often efficient and does not harm the heart, but should not be used in other conditions (for further treatment see Obstetrics).

Aside from the use of general measures given above, Sir Lauder Brunton advocates the use of blue mass or calomel routinely twice a week or even on alternate nights, followed by a saline in the morning, and also advises patients to carry nitroglycerine tablets with them, and should any pain in the chest develop take them at once. He also gives small doses of potassium iodide where sclerotic changes are evident in the peripheral vessels.

When these means of treatment have failed and there are signs of beginning cerebral trouble it is necessary to use the vasodilators or bleed.

Dr. R. D. Rudolph gives the following as to the vasodilators:

Nitroglycerine, dose of 1-100 of a grain (action lasts an hour, tolerance soon formed).

Sodium nitrite, dose of 2 grains (action lasts two hours, no tolerance acquired).

Erythrol tetra-nitrate, dose ½ grain (action lasts 6 hours, tolerance acquired).

While tolerance may not be acquired in many cases from sodium nitrite or erythrol tetra-nitrate, in many others there are very unpleasant symptoms and a marked tolerance develops.

The benefit to be derived from vasodilatation and rapid reduction of hypertension in those cases it benefits can be understood well by the evidence brought out by Dr. Charles H. Lawrence.

"Reduction of systolic pressure in cases of hypertension by nitrites, venesection, electricity, or hot air, is accompanied by a fall in diastolic pressure amounting, as a rule, to approximately one-half the systolic fall. Such a reduction produces a coef-

ficient of pressure more nearly approximating the normal than does the coefficient under the condition of hypertension.

"None of the nitrite group are efficient for maintaining a pressure at a permanently lowered level, as a tolerance is soon acquired and increasing the dose is apt to cause unpleasant symptoms."

We may also use thyroid extract in two-grain doses, three times daily.

In addition to drugs, certain mechanical, electrical, and hydrotherapeutic modes of treatment are sometimes of value. although uncertain, and their effects transitory, as a rule, e. g.,

High frequency by means of the D'Arsonval current.

Electric light baths are often valuable, stimulating circulation and increasing metabolism, and thus eliminating much waste.

Oxygen baths produce a sedative action and markedly lower tension, being of value in cases of psychic hypertension (temperature 97 deg. F.).

Wet pack is often of value in high blood-pressure in neurasthenia associated with insomnia (temperature of 70 deg. F.).

In addition we have massage, Swedish gymnastics, and vibrassage.

CHAPTER VI

HYPOTENSION

BY HYPOTENSION is meant a systolic blood-pressure of one hundred millimeters or lower. Here are included a large number of cases of asthenia, etc., but there are also a large number of persons in whom the hypotension is the result of acute infections and conditions of sudden onset, in whom the tension is low due to vasomotor depression.

In blood-pressure determinations the importance of hypertension has been allowed to outweigh the value and significance of hypotension, so that in many cases no attention has been paid to a condition that in many cases is very important and of great significance in diagnosis, prognosis, and treatment.

In the majority of cases the low pres-

sure is due more often to the depression of the vasomotor center by toxines than to cardiac weakness, though there is usually some associated cardiac involvement.

The various diseases accompanied by hypotension will be considered in alphabetical order, and where their treatment is not given under their individual heads it will be taken up under the general treatment of hypotension.

Acute Cardiac Conditions and Pericarditis.—Here pressure is low, the vasomotor center being depressed by the toxines of the disease, and there is also some weakness of the heart muscle. The systolic pressure varies from 98 to 140 mm.

Chronic Wasting Diseases.—*Cancer, Chronic Phthisis, Anemias, etc.*

There being associated brown atrophy of the heart, as a consequence there is low blood-pressure in all these conditions.

Systolic, 10-20 mm. lower than normal.

Diseases with a Marked Loss of Fluid.—*Cholera, diarrhea, dysentery,* and *after*

profuse vomiting, as in *carcinoma of the stomach, intestinal obstruction,* and *peritonitis.*

In these conditions there is a markedly lowered blood-pressure due to a large extent to the loss of fluid diminishing the volume of the circulating blood. Blood-pressure determinations are of great value in deciding as to the extent of the condition, as to the kind of treatment to be employed, and its efficacy. Lowering blood-pressure is an indication of impending collapse.

Drugs.—*Alcohol.*—In small amounts there is but little effect on blood-pressure, but in any quantity there is a vasodilatation with hypotension. Long-continued use leads to sclerotic changes and higher tension.

Tobacco.—Its moderate or occasional use produces a slight rise. When used to excess it produces low tension, due to the toxines in the tobacco.

When tension is low from tobacco all tobacco must be discontinued, as a small

quantity will continue the low tension after it is once established.

Other drugs which lower blood-pressure are: Aconite, the nitrites, the iodides, the laxatives and purgatives, chloral hydrate, pituitary extract, and thyroid extract (see treatment of hypertension). Chloroform also lowers tension (see surgery and anesthesia).

Hemorrhage, Extensive.—In these cases there is a marked drop in blood-pressure proportionate to the amount of the hemorrhage, being a mechanical result due to the lessened volume of the blood the heart has to pump. This fall in pressure is followed by a rather rapid rise to the normal level as soon as the bleeding point is secured. After securing the bleeding point the pressure is best restored by an intravenous injection of saline.

Acute Infectious Diseases.—In all infectious diseases, except meningitis, there is a fall in blood-pressure, due mainly to vasomotor depression or paralysis, from the toxines present, but also to a lesser de-

gree to the damaged heart muscle, from the same cause.

The systolic pressure usually falls below one hundred millimeters of mercury, and remains low during the acute process of the disease, and in some cases late in the convalescence.

The acute infectious diseases in which blood-pressure has a special significance will now be considered in alphabetical order.

Diphtheria.—As might be expected in a disease marked by such severe toxemia the blood-pressure is often very low. Blood-pressure values aid materially in deciding what stimulation, if any, is required, and are of great value in determining the condition of the myocardium during convalescence and deciding when to allow any physical exertion. In a condition where the danger of cardiac failure is so great any accurate means of determining the exact condition present is of inestimable value.

Pneumonia.—Here there may not be

much change in the blood-pressure, though, as the disease progresses, there is a tendency for it to lower.

Hirschfelder—Systolic	.....	110-130 mm. Hg
Diastolic	.....	90-130 mm. Hg.
Pulse rate	.....	120

Gibson of Edinburgh made a general rule which seems to work out well in patients who are *not alcoholics,* but does not apply to this class of patients. The rule is as follows: When the systolic pressure expressed in mm. of Hg is higher than the pulse rate expressed in beats per minute, the condition of the patient is good. When the systolic pressure expressed in mm. Hg is lower than the pulse rate per minute, the condition is serious.

Dr. Alexander Lambert, in a recent article, called attention to the fact that the blood-pressure varies greatly in pneumonia, but that it is of the greatest value in determining whether the condition present is one of vasomotor paralysis, due to toxines, in which case the blood-pressure

will be found to be low; or whether the patient is suffering from high tension, with cardiac failure imminent.

About one-half the cases die of vasomotor paralysis, the other half from failure of the heart. In the one, adrenalin, camphor, strychnia, and digitalis are indicated; in the other, relief of the high tension with vasodilators or bleeding is indicated.

The matter is very tersely expressed by Dr. H. A. Hare when he says:

"If the vessels be at fault the difference between diastolic and systolic pressure will be marked, the heart, if strong, sending out a forcible wave of blood in an endeavor to fill the blood paths. On the other hand, if the pressure be low from a failing heart, there will be little difference between diastolic and systolic pressure, for obvious reasons."

The blood-pressure is important not only in the beginning for diagnostic purposes, but also throughout the course of the disease in order to determine the treatment

required, and, if drugs are indicated, to regulate their dosage and the duration of their use.

Rheumatism, Acute Articular.—Here the blood-pressure is also low and the readings are of main importance in determining the treatment and progress of the case during convalescence.

Scarlet Fever.—Hypotension is present in the ordinary uncomplicated case, but should nephritis develop during the course of the disease there is a sharp, marked rise in tension. This does not take place in other infectious diseases.

Typhoid Fever.—Here we have one of the lowest pressures occurring in diseases.

Often	systolic	100-120 mm. Hg
	diastolic	60-90 mm. Hg

The systolic pressure has been as low as 75 mm. Hg.

The fall in pressure is gradual, and takes place progressively (Janeway), e. g.

First week—Systolic .....115 mm. Hg
Second week—Systolic .....106 mm. Hg
Third week—Systolic .....102 mm. Hg
Fourth week—Systolic ..... 98 mm. Hg
Fifth week—Systolic ..... 96 mm. Hg

Here the value of routine blood-pressure observations is very great, both to determine the effect and amount of treatment required, and also to be able to note the onset of complications.

In hemorrhage there is a sharp sudden fall, due to a lessened volume of blood.

In perforation just the opposite takes place, the irritation of the peritoneum causing a reflex vasoconstriction and a sudden sharp rise in blood-pressure.

The work of Briggs and Cook showed in one case a rise of blood-pressure hours before there were any other definite signs of perforation. The diagnosis was confirmed by operation. But as they demonstrated, you do not always obtain a rise in blood-pressure, for the vasomotor center may be exhausted, in which case there will be no rise. Therefore, a lack of rise in blood-pressure does not negate other signs,

and symptoms of perforation, but when high pressure is present it is reliable, unless pneumonia develops.

Using blood-pressure in conjunction with treatment they find:

Baths when favorable produced a rise in blood-pressure.

Of the drugs, strychnia and digitalis were the best to combat collapse. When used for a quick result strychnia, gr. 1-10-1-20 hypo., was given, and the resulting rise in blood-pressure was maintained for an hour or so. When the pressure begins to fall, it may be maintained by a smaller dose.

Digitalin hypo. was more certain than strychnia, with an initial dose of gr. 1-10; its action taking place earlier, though not so long continued. It often gave a rise when strychnia failed. Permanency of results may be obtained by combining the two.

Alcohol was of no value as a stimulant, but lowered pressure, and was of benefit solely as an alternative.

Thayer found, as a sequence of typhoid fever, a rather marked hypertension some years after the original attack.

Acute Infections of Children.—Here Briggs and Cook found blood-pressure determinations of the greatest value in prognosis and treatment. If pressure is falling there is danger of collapse, and it is an indication for active stimulation.

They concluded that a systolic pressure of 60 mm. during the first year, and 80 mm. in older children, were the danger lines, calling for active stimulation.

Treatment.—In collapse with cyanosis they used a mustard bath, and found that strychnia and digitalis were the most reliable drugs.

Prognosis.—A short-lived response to treatment with a renewed fall is a bad sign.

Neurological Conditions.—(a) *Alcoholic Delirium.*—Here pressure is lowered 30-40 per cent., therefore we must use care in the employment of hot packs to quiet these patients, as we may cause collapse.

(b) *Insomnia* may be associated with either one of two conditions:

1. High tension (systolic, 130-150 mm.).
2. Without high tension.

In the first vasodilators act as hypnotics and are indicated; sleep takes place as the pressure falls.

In the second class sulphonal, trional, and similar drugs are more effective.

(c) *Acute Mania.*—Here blood-pressure is low, and after an attack lower still, due to exhaustion.

(d) *Melancholia* elevates blood-pressure in proportion to the symptoms, and is relieved by vasodilators, improvement occurring coincidently with the lowering of pressure.

(e) *Neurasthenia, Hysteria, etc.*—Pressure here is variable, but becomes high readily, owing to the nervous stimulation of the vasomotor center.

(f) *General Paresis.*—Here in the early stage blood-pressure is normal, while in the late it is low.

(g) *Trifacial neuralgia* is accompanied by a high blood-pressure.

Phthisis.—Here we usually find a low systolic pressure; systolic, 90-100 mm., though it may vary between 80 and 120 mm.

Blood-pressure from the standpoint of prognosis and treatment is of considerable value, though, as to diagnosis, there is a marked difference of opinion, many thinking it of doubtful value before physical signs have developed.

Given a patient with tuberculosis a falling blood-pressure is a bad sign, while a rising blood-pressure toward the normal is equally favorable.

When the blood-pressure has reached the normal, and remained there, we may feel pretty confident our case is well; so that in supposedly cured cases it is important to take the blood-pressure observations to determine whether there is any recurrence of the disease.

Given a patient with a persistent low blood-pressure, always consider the proba-

bility of tuberculosis very seriously, especially where other causes for the low tension cannot be determined.

Lauder Brunton regards low tension as due usually to:

1. Beginning phthisis.

2. Excessive smoking; further stating that where smoking can be excluded, always examine the lungs carefully for tuberculosis.

Dr. Haven Emerson warns us that persistent low tension should put us on our guard to prevent tuberculosis, especially where the patient is under unhygienic conditions. (See *Altitude* for effect in Phthisis.)

Shock and Collapse.—Here we have a very marked and dangerous fall in blood-pressure, due to vasodilatation, from peripheral nerve stimuli to the vasomotor center. Henderson claims the vasomotor depression is due to overaeration, and lack of carbon dioxide to stimulate the center. At times the systolic pressure has been as low as 40-60 mm.

Cook and Briggs proved that the vasomotor center was not exhausted, for, by the use of strychnia and digitalis, they were often able to save apparently hopeless cases; that adrenalin intravenously will raise the pressure, but that its action is fugacious; that an intravenous saline injection is of no value to raise pressure unless adrenalin is added; and that ¼ to ½ gr. of cocaine hypo. will give an almost immediate rise of blood-pressure (10-20 mm.) and maintained from one to three hours.

Syphilis.—There is a hypotension during the acute stages due to the toxemia of the disease.

Tabes Dorsalis.—Pal concluded that, with the lightning pains, there was a marked fall in blood-pressure; in contradistinction to gastric crises, where there was an enormous rise. He assumed that as there was marked hypertension the splanchnics must be involved, and advised the use of chloral to relieve the condition

on account of its blood-pressure-lowering qualities.

The association of high tension with gastric crises aids somewhat in a differential diagnosis, as there are only two other conditions of pain in the abdomen with high tension: (1) lead colic, (2) angina abdominalis of arteriosclerosis.

Treatment of Hypotension.—(1) General hygiene and tonics.

2. Hydrotherapy is of some value, e. g., Needle bath, graduated from warm to cold. Vischy bath.

3. Massage.

4. Exercise when moderate and graduated to the needs of the individual.

5. Laxatives are of benefit where low tension is associated with constipation.

6. Especially valuable in many cases are increasing doses of tincture of nux vomica until the physiologic limit is reached.

7. Pituitrin has also been given by mouth, 2 grain doses four times a day, with marked benefit.

CHAPTER VII

SURGERY AND ANESTHESIA

SURGERY AND ANESTHESIA.—Anesthesia.—*Ether* increases the blood-pressure first reflexly from the irritation of the mucous membrane. During the second stage the pressure also rises, owing to the muscular activity.

In deep anesthesia the pressure level falls to just above the normal.

Nitrous Oxide.—Here there is a rise of pressure due partly to asphyxia. When used with ether there is an initial rise, but the second increase of pressure is eliminated, because the stage of muscular activity is avoided.

Chloroform.—Blood-pressure falls from the start, and remains low, except in pregnancy.

If, during anesthesia, shock or collapse is imminent there is a marked falling blood-pressure, before other signs are manifest; hence the value of taking blood-pressure readings every five minutes during the administration of an anesthetic. If pressure falls correct any faulty administration of anesthetic, and, if the pressure then rises, proceed. If the pressure continues to fall, or remains at a dangerous level, use active measures, and terminate operative procedure as rapidly as possible. There is less shock by continuing the ether than to allow the patient to come out, and renew the anesthetic. With a dangerous fall in blood-pressure while using chloroform, withdraw the anesthetic at once.

Spinal Anesthesia (*cocaine*).—You may have a dangerous fall due to paralysis of the upper dorsal region.

Operative Procedure.—Cutting or manipulative procedures cause a transitory rise in blood-pressure of about 10 mm. due to the pain impulses conveyed to the vaso-

motor center; it may rise again, remain low, or fall further to shock. If cocaine is injected into the nerve trunks during anesthesia there is less danger of shock.

By blood-pressure determinations we have the most accurate means not only of determining shock, but also its extent and reaction to treatment. The blood-pressure readings should be taken routinely, not only during the operation, but also before and after. Before operation often a case has a high tension, which might become dangerous if an anesthetic were administered, unless it is lowered by preparatory treatment. After operation routine observations are of value in determining the onset of shock or hemorrhage.

In addition, in pleural and peritoneal effusions, there is a rise of blood-pressure. Aspiration produces a fall, which can be determined by blood-pressure examinations and the aspiration stopped if the fall becomes dangerous.

In a recent article, "Estimation of Vital Resistance of Patient with Reference to

Possibility of Recovery," Dr. Joseph C. Bloodgood says:

"For the estimation of the factors of safety during operation and the condition of the patient directly after operation, it is my opinion that the blood-pressure apparatus is the most important.

"In the last year I have attempted to record blood-pressure measurements before, after, and during all operations, with the result that I have found these records the most important method of estimating the exact condition of the patient."

Under treatment during operation he says:

"During the last year I have paid considerable attention to the routine blood-pressure records, and at the present time I am getting the impression that the blood-pressure will warn the surgeon of the danger line before the pulse or respiration. My respect for the blood-pressure record is increasing daily, and I would urge all surgeons to use it in extraordinary operations and handicapped patients. But to

learn to interpret these records, one must employ them at all operations as a routine.

"When the blood-pressure falls to 100 or lower, it is time to stop the operation and time to give the saline, which in such cases should be given immediately. I have had a few such cases with very happy results.

"There is one point I wish to make clear which many surgeons do not seem to be familiar with. The patient seems in fair condition at the end of the operation, but no blood-pressure record is taken. He is lifted to the stretcher, carried to his room, and when put to bed is found to be in collapse requiring hurried treatment. This can be avoided in most cases if, after the operation is finished and the bandage adjusted, a blood-pressure record is taken. If the record is much lower than that taken at the end of the operation, it is an indication that the patient should not be transported, but kept quietly on the table and given the salt solution by one or all three methods. It is important therefore

carefully to investigate the patient before he is lifted from the operating table to be transported, and to begin the post-operative saline treatment then if indicated. I am confident that this will prevent many of the cases of collapse or sudden vasomotor failure which are observed after the patient reaches his bed.

"The surgeon must be familiar with the manipulations which produce shock. Nothing helps him more to estimate this than the blood-pressure. It is to be remembered that anything that either diminishes or increases the blood-pressure is a stimulation which sooner or later will lead to exhaustion and a fall in blood-pressure. It is the uniform rate of the pulse and respiration and uniform blood-pressure that indicate an operation with the least degree of shock."

CHAPTER VIII

LIFE INSURANCE

IN LIFE-INSURANCE examination, almost all companies now recognize blood-pressure estimation as a necessary procedure. The reason for this is very clearly shown in the statistics from the Northwestern Life Insurance Company, which was one of the pioneers in taking blood-pressure readings on its applicants. In a letter to their examiners they say:

"The statistics on 1,247 cases at all ages, in which there was a blood-pressure of 150 mm. mercury and over, show a mortality two and one-half times greater than the general average mortality of the company covering the same period. In 891 of these cases there was no other impairment recorded in the application when received

at the home office. All these risks would have been granted insurance had not blood-pressure been taken. A careful study of the statistics of this company demonstrates, without a doubt, that the use of the sphygmomanometer is indispensable in our examination for life insurance. The statistics also demonstrate, in our opinion, that the use of the sphygmomanometer will be of equal value to the practitioner in his general practice, and that no physician should be without this valuable aid in diagnosis.

"We feel, therefore, that it is not unreasonable to require the examiners of this company to procure an instrument and furnish the company with the blood-pressure in all examinations they make, regardless of the age or amount of insurance applied for. We shall expect, therefore, our examiners, who do not at this time possess a sphygmomanometer or have the use of one, to provide themselves with the instrument to enable them to comply with the rules of the company."

In taking blood-pressure in this class of cases there are several important factors to be considered, more fully discussed in the section on Physiological Variations (see page 50), but it might be well to repeat them. It is often well to adjust the pneumatic cuff to the patients, but not take the pressure reading for some minutes, in the meantime obtaining what data is desired from the patient, as many persons are nervous and under a mental strain when being examined. In this way you largely eliminate the nervous excitement and mental tension, which will often raise the pressure 10 or more millimeters.

The cuff should be adjusted at the heart level, the patient in a comfortable position with muscular relaxation and breathing quietly.

Pressure readings are preferably taken midway between meals. Make the actual determination as rapidly as possible, as prolonged constriction of the arm materially raises the tension (do not take over 1-3 minutes).

Make it a rule to take all observations on your applicants in the same position, either in the sitting or reclining posture.

As mental work and stimuli markedly raise the pressure, which even judicious treatment during the examination will not always eliminate, if readings are too high without any apparent organic change, ask for a subsequent examination, when the patient has rested and is free from exciting stimuli.

It is always best to obtain several readings and get an average. On numerous occasions business men have been examined during their working hours, and blood-pressure readings were found to be considerably too high, but the same men after a few hours rest have had a normal blood-pressure and have been accepted without a doubt in the mind of the examiner. In some cases, if the tension is still high or the readings are on the border line, it is important to take a number of readings.

Aside from these general precautions

there are not any factors influencing blood-pressure readings to any marked degree. Even age, which has been greatly emphasized in the past, is not a great factor. The status of age in relation to blood-pressure is clearly expressed by Dr. Henry Wireman Cook:

"Age after childhood is constantly assuming a less and less important place as a factor in normal blood-pressure variations. In early observations high blood-pressure at older ages was found of so much greater relative frequency that practically all observers were led into the belief that much higher blood-pressures were normal at the older ages than is actually the case. This partly rose from the use of a narrow arm-piece, which unduly emphasized any increase, but probably in most part the mistake was due to the fact that the cardiovascular and renal changes are so much more common after forty-five. Later and more accurate observations, however, showed that there is very little normal increase in the blood-pressure before sixty

years of age, and when a marked hypertension is present it is associated with a distinct abnormality of tissue function. Authoritative data on this subject are most convincing."

In over two hundred consecutive blood-pressure observations Janeway saw 145 mm. Hg exceeded only once or twice, except where cause for hypertension existed. In routine examinations of many hundreds of cases he never saw a pressure above 160 mm. in a normal person—seldom one above 140 mm. (wide arm-piece). He regards with suspicion any pressure over 145 mm. His later statement, March, 1911, is "A blood-pressure reading of more than 145 mm. before middle life or of more than 160 mm. after must be considered abnormal."

Before closing I wish to call attention to some aspects of blood-pressure in relation to life-insurance examination, which in the past have received very little attention:

First, the value in doubtful cases of the use of the functional test of the myocar-

dium, by a regulated amount of exercise with blood-pressure readings (see Heart Diseases, page 77).

Second, the importance of routinely taking the diastolic blood-pressure as well as the systolic, as the pulse pressure (difference between the systolic and the diastolic) is often invaluable in determining the amount of arteriosclerosis present; as already has been described there are a number of patients in whom the systolic pressure is at the normal level, but who have had a high systolic pressure until the myocardium has given away and the hypertension could no longer be maintained. Here the diastolic pressure remains relatively high, giving a small pulse pressure and making the diagnosis of arteriosclerosis, with associated myocarditis.

More attention should be paid to hypotension, in relation to tuberculosis.

Diseases to consider are: chronic interstitial nephritis, cardiac diseases, arteriosclerosis, angina sclerosis and tuberculosis.

CHAPTER IX

BLOOD PRESSURE IN CHILDREN

WHILE there has been considerable research to determine the normal range of blood-pressure readings in adults, comparatively little careful work has been done in children.

Several authors have stated that blood-pressure readings in children were of little or no value and emphasized the difficulty of obtaining accurate readings.

Feeling that a large part of the skepticism about blood-pressure readings in children was due to a lack of a careful technique and a sufficient series of observations, Dr. C. F. Judson and the author* conducted a series of investigations in the endeavor to establish, if possible, a normal standard of blood-pressure in children.

* Blood-Pressure in Normal Children, by C. F. Judson and Percival Nicholson. Read at Atlantic City, June 24, 1914, A.M.A. Section on Pediatrics. Full article will appear in *American Journal of Diseases of Children.*

In the investigations three methods of observation were employed. Auscultation, and oscillation by a modified Fedde-Hoobler pith ball apparatus, and a modified Erlanger apparatus devised by the author. Readings were taken on children ranging from three to fifteen years.

A review of the work of previous investigators and a full description of technique will be found in the original article.

Before considering the conclusions reached it is important to understand that, owing to certain differences in the cardiovascular system of children, the blood-pressure readings do not conform to those of the adult. "Owing to the relatively more elastic and distensible arterioles and capillaries found in children, the peripheral resistance is less marked than in adults and the vessel walls are in a less stable state of equilibrium. This simply means that the systolic blood-pressure is a more direct representation of the work of the heart than in the adult."

The systolic pressure varies with the

age of the child, and readings taken on children of the same age vary according to weight and height.

Sex has but slight influence on blood-pressure in contradistinction to that of the adult.

In healthy children breathing does not influence blood-pressure unless respirations are deep, forced, and prolonged.

In using the auscultation method the beginning of the fourth phase (dull sound) was taken as the correct criteria for determining the diastolic pressure, and special care was observed in all readings to see that the pneumatic pad of the arm band was directly over the line of the artery and completely deflated between readings. In children we found much more satisfactory results were obtained by using the arm, the size of the pneumatic cuff depending on the age of the child. I shall quote our conclusions.

"Our studies started one year and a half ago and cover some two thousand three hundred observations. We believe we have

established a standard of blood-pressure in the normal child between the ages of three and fifteen years. The results obtained with the modified Erlanger apparatus we have taken as a standard." "Comparison of the results obtained by the conjoint use of the auscultation and modified Erlanger methods further confirms their accuracy." "The systolic pressure shows a slight but gradual rise from three to ten years. From ten to fourteen years the increase is more abrupt, with a rapid elevation in the fourteenth year during adolescence. Our results show that the systolic pressure is higher than that generally accepted, and does not show any arithmetical increase from year to year. The total rise in systolic pressure from four to fourteen years is represented by only fourteen millimeters of mercury.

"In contrast to the systolic pressure the diastolic remains at an almost uniform level, and the pulse pressure increases progressively and proportionally more than the systolic pressure over the corresponding period.

"Comparing the systolic pressure of four years with that of fourteen years, we find an increase of sixteen per cent., whereas the increase in the pulse pressure during the same period amounts to forty-five per cent.

"Comparing the results obtained by using cuffs of different width, we find that, from four to eight years, the nine centimeter cuff gives as accurate results as when wider ones are used (11 to 13 centimeters). From eight to fifteen years, we find more accurate results when using the thirteen centimeter cuff." "Comparison of the results obtained by the auscultation method with those of the modified Erlanger method shows remarkable uniformity in the readings. The auscultation method requires no complicated apparatus, is easily carried out, and gives accurate results if the necessary precautions are taken to observe correct technique, especially as to the mode of application and width of the cuff."

"In closing we must insist on the importance of repeated observations in a given case before reaching conclusions.

Blood Pressure in Normal Children

YEARS	3		4		5		6		7		8		9		10		11		12		13		14		15	
NAME	SYS	BIAS	SYS	BIAS	SYS	BIAS	SYS	BIAS	SYS	BIAS	SYS	BIAS	SYS	BIAS	SYS	BIAS	SYS	BIAS	SYS	BIAS	SYS	BIAS	SYS	BIAS	SYS	BIAS
L Gordon MILLIMETRES METHOD 12 CM - CUFF	81	-	83	-	86.5	-	88.5	-	85	-	93	-	100	-	95	-	104	-	105	-	-	-	-	-	-	-
Stowell MILLIMETRES METHOD 12 CM - CUFF	91	-	89	-	95	-	96	-	102	-	101	-	102	-	112	-	102	-	111	-	107	-	110	-	109	-
Leitão ERLANGER 6 CM CUFF	91	65	99	71	99	71	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kaupe MILLIMETRES 12 CM - CUFF	90	81.8	86.4	78.3	82.2	74	97.5	82.1	91	78	90.5	80.2	90	81.5	97.7	82.6	96	87.2	92	83.1	96.6	88	107	96	-	-
W Kriss ABSOLUTE MILLIMETRES 8 CM - CUFF	80	74	83	76	83	76	90	82	90	82	90	88	90	88	98	90	98	90	99	95	99	95	101	96	101	96
Kaltenbecker ABSOLUTE MILLIMETRES 8 CM - CUFF	-	-	93	54	94.5	54	82	53	-	-	103	55	100.6	58.6	104.6	69.5	99.8	78.8	108.2	68.2	107.7	70.2	109.2	71.2	-	-
Judson & Nicholson MILLIMETRES 8 CM - CUFF	91.6	65.6	91.6	64.9	91.3	64.4	92.6	67.3	94.4	66.9	93.6	64.7	94.3	71	99.2	67.1	97.1	65.5	102.3	65.2	103.6	70.5	106.1	67.4	105.6	67.5

"The figures in our tables represent the average of a large number of readings; we do not claim that they are an absolute standard. While in the individual child

Blood Pressure in Normal Children

YRS.	W. C. (CM)	OBS.	BETW. CIR. EX. (CM.)	ERLANGER MOD. S. P.	D. P	P. P.	P
3	9	24	13½ TO 14	91.8	65.6	26.2	92
4	9	95	13 TO 16½	91.6	64.9	26.7	99
5	9	69	13 TO 18	91.3	64.4	26.9	93
6	9	110	13 TO 16	92.6	67.3	25.3	95
7	9	145	14½ TO 17½	94.4	66.4	28	87
8	13	128	15 TO 20	93.6	64.7	28.9	88
9	13	149	16 TO 19	94.3	71	23.3	84
10	13	203	15 TO 19½	99.2	67.1	32.1	87
11	13	169	15 TO 20½	97.1	65.6	31.5	87
12	13	94	17 TO 24	102.3	65.2	37.1	89
13	13	80	14 TO 22½	103.6	70.5	33.1	96
14	13	43	18½ TO 25	106.1	67.4	38.7	84
15	13	25	17½ TO 24	105.6	67.5	38.1	84

the variations in the systolic pressure may be considerable, diastolic pressure remains fairly constant. The importance of determining the diastolic pressure in every case

cannot be too strongly emphasized. The determination of the pulse pressure, indicating as it does the peripheral resistance, is the most important point to be determined in children."

Results are clearly seen in the two tables appended.

It is important to remember that the relatively small heart and larger vessels of the child change at puberty, and as a result of the increase in size of the heart the blood-pressure is elevated and assumes the adult type.

There are a number of children who at puberty may even have a higher systolic pressure than young adults, and yet have no demonstrable cardiovascular abnormality aside from a slight cardiac hypertrophy. In all probability this is due to an overcompensation on the part of nature for the increased circulatory requirements incident to puberty, and is purely a temporary condition, soon disappearing as a correct equilibrium is established.

Some blood-pressure readings have been

reported for infancy, but owing to the difficulty of their determination the results are doubtful and of not much practical significance.

As the normal blood-pressure readings in children have only recently been the subject of investigation there has not been much valuable work on pathologic conditions.

Dr. J. D. Rolleston* conducted a series of observations on children suffering from diphtheria.

He divided the cases into (1) very severe, (2) severe, (3) moderate, (4) mild.

In very severe cases blood-pressure shows a continual decline. In severe cases the fall is not so marked but obvious. In moderate and mild cases the fall in blood-pressure is trivial.

Cases with laryngeal obstruction always gave elevated blood-pressure.

The cases of paralysis he divided into (1) early, (2) late.

In the early cases a fall in blood-

* *British Jour. Diseases of Children*, October, 1911.

pressure was always marked. In late cases either there was no change or a rise.

"The significance of this difference will be better understood when it is added that the early palsies include most of the cases in which there was heart failure. A low pressure in such cases gives a bad prognosis."

In acute nephritis Lennox Gordon* has found a very marked hypertension, and as there is no other disease of childhood giving the same high readings it is of distinct diagnostic value. As the symptoms and urine clear up there is a rapid fall of pressure to the normal.

In scarlet fever at the onset of a complicating nephritis there is a very marked and sudden rise in blood-pressure, affording a very valuable means of diagnosing this complication.

Some interesting work has been done on effect of cold air in pneumonia of children by Doctors Howland and Hoobler, from

* *Archives Pediatrics*, May, 1911.

which they found the following conclusions: (1) That cold air produced a rise in blood-pressure. (2) That the elevation of pressure was marked and remained up as long as the child was exposed to the cold. (3) That on a return to a warm ward there was an immediate fall in blood-pressure. (4) That as only the child's face was exposed to the air the reflex stimulation of the vasomotor centre was due solely to the effect of cold on the nose and skin of the face. (5) That when the blood-pressure was abnormally low an increase accomplished without disturbance to the patient, and which is maintained causing no exhaustion, was of the greatest value. (6) They recognize that the determination of the blood-pressure does not give all the information about the circulation there is to know, but they consider that with the ordinary methods of physical examination it gives the best indication of the circulatory condition. (7) Fresh air which was warm they did not find caused an elevation of blood-pressure.

Along similar lines Dr. Hoobler* conducted a series of observations on the effect of cold air in children with tuberculosis. He found blood-pressure persistently low, as in adults, and that when the patient was transferred to the open air there was a gradual rise in blood-pressure sustained as long as the patient remained in the open air.

In gastro-enteric conditions there is probably a fall in blood-pressure proportionate to the severity of the purgation or vomiting, though sufficient accurate work has not been done to establish the point, owing to the difficulty of securing patients sufficiently quiet to obtain accurate readings.

In the broncho-pneumonias of children we do not find that Gibson's rule is applicable, owing to the rapid pulse of childhood. The blood-pressure field in childhood has been but touched upon so far.

The author sees no reason why it is not now possible to carry on extended and very valuable blood-pressure studies in patho-

* *Jour. American Med. Asso.*, November, 1912.

logic conditions of children from three to fifteen years; but so far finds it exceedingly difficult below that age.

The importance of routine observation of blood-pressure in children as in adults should be clearly understood and careful observations made of both the systolic, diastolic, and pulse pressures.

BIBLIOGRAPHY

BARACH, J. H. Blood pressure and other observations in hypertrophy and dilatation of the heart. Pennsylvania Medical Journal, May, 1911.

——Blood pressure past middle life in diagnosis, prognosis, and treatment. Pennsylvania Medical Journal, December, 1910.

BARKER, L. F. Paroxysmal arteriosclerosis with hypertension in the gastric crises of tabes. Journal American Medical Sciences, Vol. CXXXLX.

BLOODGOOD, JOS. C. Estimation of vital resistance of patient with reference to the possibility of recovery. Annals of Surgery, May, 1912.

BROOKS, HARLOW, and CARROLL. Clinical study of the effects of sleep and rest on blood pressure. Archives of Internal Medicine, August 15, 1912.

BRUNTON, L. Clinical measurement of diastolic blood pressure and cardiac strength. British Medical Journal, November 5, 1910.

BRUNTON, T. L. Physical aspects of blood pressure. Medical Press and Circular, London, November 2, 1910.

COHEN, H. M. Blood pressure in surgery. Col. Med., February, 1910.

COOK, H. W. Blood pressure in prognosis. N. Y. Medical Record, November 1, 1911.

COOK and BRIGGS. Clinical observations on blood pressure. Johns Hopkins Hospital Report, 1903.

EDGECOMBE, W. Low blood pressure. Practitioner, London, April, 1911.

ELLIOT, A. R. Arterial hypertension. American Journal of Medical Sciences, Philadelphia, 1910.

EMERSON, H. Blood in tuberculosis. Archives of Internal Medicine, Chicago, April, 1911.

FAIRLIE, H. P. Behavior of blood pressure in chloroform and ether anæsthesia, with special reference to shock. Practitioner, London, February, 1911.

FISHER, J. W. Diagnostic value of the use of the sphygmomanometer in examinations for life insurance. Abstract of Proceedings Med. Life Insurance Directors of America, October, 1912.

GILBERT, O. M. Medical aspects of blood pressure. Col. Med., February, 1910.

GITTINGS, J. C. Auscultatory blood pressure determinations. Archives of Internal Med., August, 1910.

GOEPP, R. M. High arterial tension. Penn. Medical Journal, April, 1911.

GOODMAN, E. H., and HOWELL, A. A. Clinical studies in the auscultatory method of determining blood pressure. Meeting of Medical Society of Pennsylvania, October, 1910.

GORDON, L. Blood pressure in cases of acute nephritis of children. Archives of Pediatrics, May, 1911.

GREEN, R. M. Blood pressure in the toxemia of pregnancy. Boston Medical and Surgical Journal, April 28, 1910.

HARE, H. A. Difference between systolic pressure in the arm and in the leg in aortic regurgitation. Therap. Gazette, July, 1910.

HIRSCHFELDER, D. A. Diseases of the heart and aorta. Lippincott.

HIRST, J. C. Importance of blood pressure in the toxemia of the latter half of pregnancy. N. Y. Medical Journal, June 1, 1910.

HUDSON. High blood pressure, its treatment by non-medicinal methods. Practitioner, London, September, 1911.

JACKSON, E. Blood pressure from the stand-

point of the ophthalmologist. Journal of the American Med. Association, March 26, 1910.

JANEWAY, T. C. Clinical study of blood pressure. Appleton, 1904.

——When should the general practitioner measure the blood pressure? Albany Medical Annals, March, 1911.

LAMBERT, ALEX. Blood pressure in pneumonia, considered as a terminal infection, upon treatment. Therap. Gazette, 1911.

LAWRENCE, C. H. Effect of pressure-lowering drugs and therapeutic measures on systolic and diastolic pressure in man. Archives of Int. Med., April 15, 1912.

MACKENZIE, JAMES. Diseases of the heart. Oxford University Press.

MCKITTRICK, P. The clinical significance of high blood pressure, its causes and treatment. Wisconsin Med. Journal, February, 1911.

MICHAEL, MAY. Study of blood pressure in normal children. Chicago Pediatric Society, January 17, 1911.

MILLER, J. L. Hypertension and the value of the various methods for its reduction. Journal American Med. Association, May 21, 1910.

NEUHAUS, G. E. Blood pressure from the neu-

rologic standpoint. Col. Med., February, 1910.

OSLER, WILLIAM. Principles and practice of medicine. 8th ed. Appleton.

OTIS, EDWARD. Physical exercise and blood pressure. Med. Record, September 30, 1911.

PETER, L. C. Arterial hypertension and its relation to morbid changes in the eye. Penn. Med. Journal, March, 1911.

ROBINSON, G. C. Blood pressure in epidemic cerebro-spinal meningitis. Archives of Internal Medicine, Chicago, May, 1910.

RUDOLPH, R. D. High blood pressure in arteriosclerosis. British Medical Journal, November 26, 1910.

SHELDON, W. H. Long continued high blood pressure, its results and prevention. Medical Record, December 31, 1910.

STARLING, H. J. Value of blood pressure determinations in the toxemia of pregnancy. London Lancet, September, 1910.

SWAN, JOHN M. Influence of carbonated brine baths (Nauheim) on blood pressure. Archives of Internal Medicine, August 15, 1912.

VISSCHER, L. G. Treatment of chronic hypertension. Journal of Amer. Med. Association, December 2, 1911.

VOYLER, W. J. The blood pressure during

pregnancy and the puerperium. Amer. Journal of Obstetrics, Vol. LX, 1907.

WARFIELD, LOUIS N. The osculatory blood pressure phenomenon. Interstate Med. Journal, October, 1912.

——Studies in auscultatory blood pressure phenomena. Journal American Med. Association, October 4, 1913.

WIGGERS, C. J. Prognostic significance of pulse pressure changes during hemorrhage. Archives of Internal Medicine, September, 1910.

WOOLEY, H. P. Normal variation of systolic blood pressure. Journal American Med. Association, July 9, 1910.

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FIG. 2.—Cook's modification of the Riva-Rocci sphygmomanometer, showing narrow arm-band in place, with cautery bulb-inflator.

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